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Great Lakes Water Quality Seventh Annual Report 1978 to the International Joint Commission

Great Lakes Water Quality Board

GREAT LAKES WATER QUALITY BOARD

INTERNATIONAL JOINT COMMISSION

GREAT LAKES WATER QUALITY 1978 ANNUAL REPORT

GREAT LAKES WATER QUALITY

SEVENTH ANNUAL REPORT TO THE INTERNATIONAL JOINT COMMISSION

GREAT LAKES
WATER QUALITY BOARD
JULY 1979

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GREAT LAKES
WATER
QUALITY

INTERNATIONAL JOINT COMMISSION
GREAT LAKES WATER QUALITY BOARD

July 1979

International Joint Commission
Canada and United States

Gentlemen:

The International Great Lakes Water Quality Board, as a requirement of the Water Quality Agreement of 1972, is submitting the following Annual Report on Great Lakes Water Quality prepared by the Board.

Respectfully submitted,

R. W. Slater
Chairman
Canadian Section

T. C. Jorling
Chairman
United States Section

PREFACE

The Seventh Annual Report of the Great Lakes Water Quality Board to the International Joint Commission reviews the progress made by the United States and Canada to comply with the goals of the 1972 Great Lakes Water Quality Agreement. This is the final report under the 1972 Agreement.

In accordance with the provisions of the 1972 Agreement, the Governments conducted a comprehensive review of the operation and effectiveness of the Agreement during the fifth year after its coming into force. In November 1978 the Governments of Canada and the United States, having decided that the 1972 Agreement and subsequent reports by the International Joint Commission provided a sound basis for new and more effective cooperative actions to restore and enhance water quality in the Great Lakes ecosystem, signed a new Agreement. Future reports by the Water Quality Board will advise the Commission on the progress and effectiveness of the 1978 Water Quality Agreement.

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RECOMMENDATIONS

The Water Quality Board presents the following recommendations to the International Joint Commission for its consideration. The Board urges the Commission to adopt these recommendations and forward those applicable to Governments.

1. IN LIGHT OF THE URGENCY FOR THE ESTABLISHMENT OF WASTE DISPOSAL FACILITIES IN THE BASIN AND THE ADVERSE PUBLIC REACTION TO SITING PROPOSALS, IT IS RECOMMENDED THAT THE COMMISSION CONSIDER TAKING EXTRAORDINARY ACTION, INCLUDING PUBLIC HEARINGS, TO INCREASE THE PUBLIC AWARENESS OF THE NECESSITY FOR SUCH FACILITIES.

2. TO SUPPORT TOXIC SUBSTANCE CONTROL PROGRAMS OF EACH JURISDICTION AND IN THE INTEREST OF COORDINATING THE TOXIC SUBSTANCE CONTROL PROGRAMS, THE COMMISSION SHOULD SPONSOR THE ESTABLISHMENT OF A WORK GROUP TO UNDERTAKE HAZARD ASSESSMENT OF SUBSTANCES FOUND IN THE GREAT LAKES ECOSYSTEM. THE SUCCESS OF THIS EFFORT REQUIRES THE COMMITMENT OF AGENCIES TO PARTICIPATE AND TO CONSIDER THE ASSESSMENTS IN THEIR INDIVIDUAL PROGRAMS.

3. RECOGNIZING THAT ANALYTICAL CAPABILITY IS A CONSTRAINT ON IMPLEMENTATION OF TOXIC SUBSTANCES PROGRAMS, IT IS RECOMMENDED THAT ALL JURISDICTIONS ASSESS THE ADEQUACY OF THEIR CAPABILITY TO ANALYZE TOXIC COMPOUNDS AND TAKE NECESSARY MEASURES TO PROVIDE LABORATORY FACILITIES AND SKILLED PERSONNEL TO MEET THE ANALYTICAL REQUIREMENTS OF A TOXICANT PROGRAM.

4. IN LIGHT OF THE HUMAN HEALTH AND ENVIRONMENTAL HAZARDS ASSOCIATED WITH SOME ABANDONED WASTE DISPOSAL SITES, IT IS RECOMMENDED THAT ALL JURISDICTIONS INVENTORY SUCH SITES AND ASSESS THEIR EFFECTS.

5. IN ORDER TO REDUCE THE EFFECTS OF ACIDIC PRECIPITATION, IT IS RECOMMENDED THAT THE GOVERNMENTS OF CANADA AND THE UNITED STATES UNDERTAKE ACTIONS TO REDUCE ATMOSPHERIC EMISSIONS OF OXIDES OF SULPHUR AND NITROGEN FROM EXISTING, AS WELL AS NEW SOURCES.

6. IN ORDER TO MEET PHOSPHORUS CONTROL OBJECTIVES, THE WATER QUALITY BOARD RECOMMENDS RENEWED EMPHASIS ON THE OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT FACILITIES.

7. AS AN ADDITIONAL INCENTIVE TO IMPROVE OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT FACILITIES, THE COMMISSION SHOULD CONSIDER MAKING AN ANNUAL AWARD TO THE OPERATOR OF THE BEST MUNICIPAL FACILITY IN THE GREAT LAKES BASIN.

1 HIGHLIGHTS

WATER QUALITY

- There are forty-eight problem areas where water quality objectives or standards were exceeded, one more than reported in 1977. Two new problem areas were identified: at Mississauga, Ontario on Lake Ontario; and at Grass River, New York on the St. Lawrence River. In Michigan, the Pine River, which discharges to the St. Clair River, is no longer considered a problem area.

- Decreases in the concentration of DDT, DDE, dieldrin, HCB, mirex, and PCBs in herring gull eggs from lakes Superior, Huron, Erie, and Ontario were observed in 1978. The low reproductive success of herring gull populations that was reported last year in Lake Ontario is no longer apparent. Herring gull reproduction rates now appear normal in all boundary lakes. Studies of reproduction rates of herring gull eggs were initiated last year in Lake Michigan.

- PCBs in eastern Lake Michigan coho salmon from the Platte and Grand rivers (Michigan) and bloater chubs from Saugatuck, Michigan continued to decline in 1978.

- New compounds detected in herring gull eggs from Lake Erie previously not reported by the Board include polychlorinated terphenyls. PCTs have environmental characteristics similar to those of PCBs.

- Trace levels of dioxin were reported in fish from Lake Ontario and Saginaw Bay. Further assessments of the presence of environmental effects and possible sources of this contaminant are required.

- Total phosphorus concentrations declined in Lake Michigan between 1976 and 1977. Declines in total phosphorus levels were also noted in Lake Ontario between 1977 and 1978. Comparisons of data between 1970 and 1978 in Lake Ontario indicate a significant downward trend in whole lake total phosphorus concentration. The greatest decline between 1977 and 1978 was observed near Toronto.

REGULATORY AND REMEDIAL PROGRAMS

- Point source remedial programs to control conventional pollutants required by the 1972 Agreement are well underway; however, further work is required to control nonpoint sources, and concerted efforts are needed to control toxic substances.

- Sixteen of the 48 problem areas where remedial programs are underway may require further corrective action because of nonpoint pollution and storm and combined sewer overflows. Of the remaining 32 problem areas, 6 are in locations where remedial programs are completed and improvements in water quality can be expected to follow.

- There has been a significant increase in the numbers of facilities in compliance with domestic pollution control programs: 71 percent in the United States and 73 percent in Canada in 1978 compared with 51 percent and 64 percent, respectively in 1977.

- Major legal actions were taken against 15 dischargers in the United States and 5 in Canada in 1978.

- During 1978, the United States and Canada committed $618 million and $191 million, respectively, for construction of municipal sewage treatment plants.

- A substantial drop in point source municipal phosphorus loading to the Great Lakes Basin has occurred. Aggregate Great Lakes concentrations of phosphorus (total load divided by total flow) in municipal point sources have dropped from 2.6 mg/L in 1975 to 1.8 mg/L in 1978.

TOXIC SUBSTANCES AND HAZARDOUS WASTES

- The Board recognizes that a coordinated program to evaluate hazards to human health and the environment must be developed in the Basin. A small work group should be established to undertake hazard assessment associated with the substances in the Great Lakes Basin previously reported by the Board. This effort requires the commitment of agencies to participate in the program and utilize the assessments in their control programs.

- Hazardous waste disposal is a serious problem in the drainage basin. No new sites were developed in 1978. Thus, there is uncertainty about the secure storage of hazardous waste. Resistance of citizens to locating sites for disposal of hazardous wastes in their communities is a major factor in the denial of site approval.

- The Board continues to be concerned with the hesitation of some agencies to accept the concept of interjurisdictional movement of hazardous wastes to approved disposal facilities.

2 WATER QUALITY ASSESSMENT

WHOLE LAKE ASSESSMENTS

The 1972 Great Lakes Water Quality Agreement placed major emphasis on eutrophication and the control of phosphorus loadings to the Great Lakes. The 1978 Agreement continues to place importance on the need for more definitive information on nutrient loadings, and new emphasis is given to persistent contaminants in the Great Lakes Basin ecosystem. Available information on contaminant levels is highlighted at the beginning of the water quality assessments of each of the lakes. Nutrient load information is presented in Appendix B of this report.

Annual main lake surveillance programs are not conducted on lakes Huron and Superior. Surveillance activities in these lakes are focussed on problem areas assessment, assessment of contaminant levels in fish and wildlife, and the measurement of tributary and atmospheric loadings of phosphorus and other contaminants. Intensive studies of these two lakes are scheduled for 1980 and 1983, respectively.

LAKE MICHIGAN

Two years of intensive surveillance activities on Lake Michigan were completed in 1977. These studies were coordinated by the United States Environmental Protection Agency (EPA) and carried out as part of the Great Lakes International Surveillance Plan. Chemical, physical, biological and microbiological data were obtained in the open waters and nearshore zones. These studies primarily addressed the effects of nutrient removal programs and bans on pesticides and PCBs.

Results of these intensive studies and the annual surveys of 1978 are summarized briefly below. A more detailed water quality report on the 1976-1977 Lake Michigan intensive survey will be published by the United States EPA.

CONTAMINANTS

Declines of PCBs in eastern Lake Michigan coho salmon and bloater chubs as reported by the Board last year continued in 1978. The Board noted, however, that preliminary information from western Lake Michigan shows no similar decline in PCB levels. Since 1975, PCB levels in coho salmon have declined as much as 50 percent in eastern Lake Michigan. However in 1978, levels in fillets were still well above the Agreement objective of 0.1 µg/g (whole fish). In bloater chubs, PCBs have been declining since 1972 (Figure 2.1 and Table 2.1).

Residue levels of DDT in bloater chubs have declined and, since 1976, have been below the Agreement objective of 1.0 µg/g in whole fish.

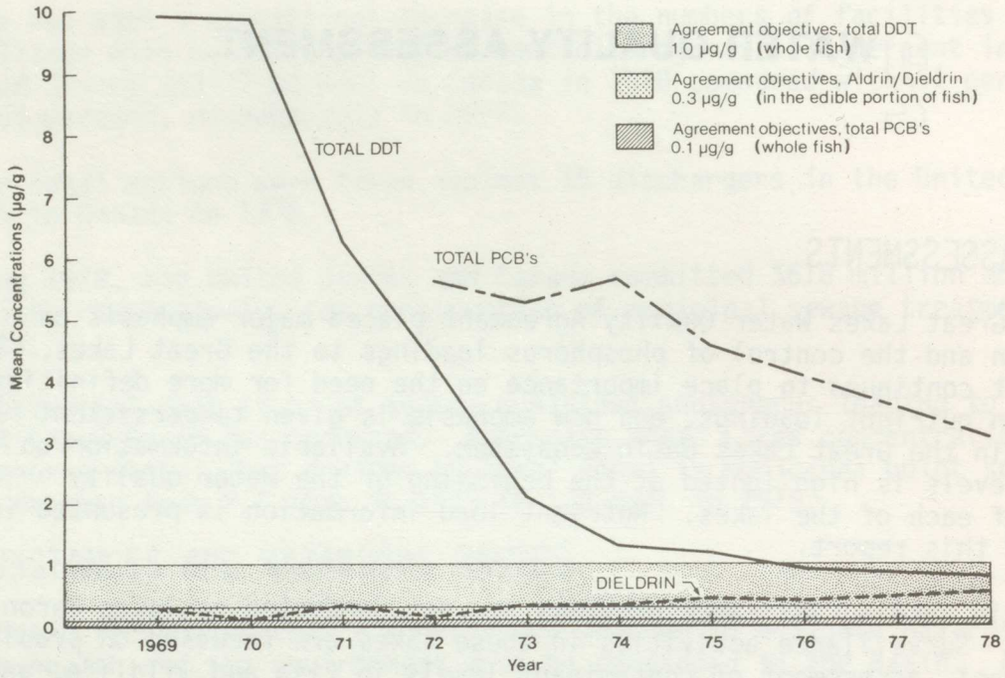


Fig. 2.1 MEAN CONCENTRATIONS (whole fish) OF CHLORINATED HYDROCARBONS IN BLOATER CHUBS FROM EASTERN LAKE MICHIGAN (near Saugatuck Michigan)

TABLE 2.1

ORGANIC CONTAMINANTS IN GREAT LAKES

ORGANIC CONTAMINANTS	OBJECTIVE (µg/g)	CONCENTRATION (µg/g)							WATER (µg/L)
		COHO SALMON	BLOATER CHUBS	SPOTTAIL SHINERS	SMELT	YELLOW PERCH	LAKE TROUT	RAINBOW TROUT	
			LAKE MICHIGAN						
PCB	0.1	1978-2.4 to 5.04	1976-4.11 1978-3.08						
DDT	1.0		1969-9.94 1978-0.81						
Dieldrin	0.3		1969-0.27 1978-0.55						
			LAKE ERIE						
Mercury		0.15		0.04-0.05	0.05	0.09			0.61
PCB	0.1	0.91			0.23	0.22			
Dieldrin	0.3	0.25							
			LAKE ONTARIO						
PCB	0.1	3.07			1.5	0.74	5.24	1.55	

Dieldrin levels in bloater chubs have increased to almost double the Agreement objective; levels in coho salmon appear to be declining.

Dieldrin levels are also high in herring gull eggs as are residues of other organochlorines, especially PCBs (Table 2.2).

Although reproductive success of Lake Michigan herring gulls was not measured in 1978, this component of the early warning program will be developed in the near future.

EUTROPHICATION

Historical data and the results of the intensive studies conducted on Lake Michigan in 1976-1977 show increasing concentrations of total phosphorus, although the lake can still be considered oligotrophic. Dissolved reactive phosphorus, which is the primary form of phosphorus used by phytoplankton for growth, was generally less than the limit of detectability (2 µg/L). Mean annual lakewide total phosphorus and chlorophyll a concentration contours are presented for 1976 and 1977 in Figures 2.2 and 2.3. Analysis of phosphorus and chlorophyll a levels for 1976 and 1977 indicated a 3 µg/L decrease of total phosphorus and a small decrease in algal crops. Remedial programs alone cannot explain the magnitude of the phosphorus decrease in the southern basin.

Declines in the phosphorus content in the southern basin near the Illinois and Indiana shoreline are strongly linked to remedial programs, including the diversion out of the basin of 12 municipal plants and one industry in Lake County, Illinois in the years from 1973 through 1978, Indiana's phosphate detergent ban in 1972 and 1973, and pollution abatement programs undertaken by northwest Indiana industries.

Chloride is increasing more rapidly than in the past (average annual rate is about 0.12 mg/L/yr). Sodium and sulfate levels increased in the Grand Haven area during 1976 and 1977. Although the impact of increased conservative ion concentrations in Lake Michigan is still a matter of debate, some investigators have suggested that increased levels of dissolved solids may alter phytoplankton community structure and, consequently, adversely affect the fisheries of Lake Michigan.

LAKE SUPERIOR

Lake Superior was intensively surveyed during the Upper Lakes Reference studies in 1974, and further open lake studies are scheduled for 1983. During 1978, contaminant and problem area surveillance studies were conducted in accordance with the Great Lakes International Surveillance Plan (GLISP).

CONTAMINANTS

Mercury levels were above the 0.5 µg/g Agreement objective in whitefish, lake trout, and suckers along the Ontario shoreline (Thunder Bay, Pine Bay, Rossport, Peninsula Harbour, Michipicoten Bay, Batchawana Bay and Mamainse Point). There is evidence of a decline of mercury concentrations in some species at Peninsula Harbour, although concentrations of 1.5 µg/g were observed in suckers from this area.

TABLE 2.2

RESIDUE LEVELS IN HERRING GULL EGGS, GREAT LAKES[1]

(µg/g) parts per million fresh weight

	DDE		DDT		DIELDRIN		HCB		MIREX		PCB	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
HAT ISLAND, LAKE MICHIGAN												
1977	112	36	28	9.0	0.16	.05	0.21	.29	0.72	.60	0.12	.09
GULL ISLAND, LAKE MICHIGAN												
1978	92	35	23	8.0	0.12	.06	0.15	.10	0.80	.35	0.12	.05
BELLOWS ISLAND, LAKE MICHIGAN												
1978	101	46	23	10	0.2	.05	0.33	.60	0.89	.38	0.13	.09
MAMAINSE ISLAND, LAKE SUPERIOR												
1974	14	4.1	0.82	.47	0.42	.15	0.30	.14	0.76	.66	50	10
1975	22	8.6	0.72	.67	0.32	.11	0.26	.08	1.3	1.7	70	37
1977	12	4.3	0.07	.06	0.40	.17	0.13	.06	0.42	.79	56	20
1978[2]	9.7	4.8	0.10	.10	0.40	.43	0.09	.05	0.15	.16	37	16
GRANITE ISLAND, LAKE SUPERIOR												
1974[2]	19	7.0	0.83	.44	0.61	.17	0.22	.12	1.4	.73	75	18
1975	24	11	0.25	.12	0.44	.34	0.21	.12	0.62	.37	82	33
1977	11	6.9	0.06	.03	0.35	.16	0.12	.07	0.24	.23	55	22
1978	9.6	3.3	0.12	.05	0.39	.17	0.14	.06	0.39	.48	45	11
CHANTRY ISLAND, LAKE HURON												
1974	21	8.6	0.63	.23	0.47	.18	0.47	.23	2.2	2.1	86	22
1975	12	4.4	0.04	.03	0.31	.20	0.17	.05	0.48	.56	39	17
1977	13	4.6	0.09	.05	0.57	.25	0.17	.08	0.34	.22	64	16
1978	6.0	2.5	0.05	.03	0.22	.09	0.14	.07	0.26	.33	32	12
DOUBLE ISLAND, LAKE HURON												
1974	14	6.7	0.55	.28	0.53	.16	0.30	.08	0.52	.22	56	17
1975	16	8.5	0.17	.10	0.41	.18	0.24	.08	0.55	.67	46	15
1977	19	15	0.09	.07	0.51	.24	0.21	.05	0.55	.57	77	48
1978	7.0	2.6	0.09	.02	0.22	.12	0.09	.05	0.16	.22	33	9.5
PORT COLBORNE, LAKE ERIE												
1974	8.7	3.3	0.23	.07	0.37	.13	0.21	.05	0.84	.51	73	20
1975	7.9	1.8	0.10	.06	0.38	.14	0.17	.05	0.42	.17	53	14
1977	7.6	1.7	0.06	.03	0.50	.26	0.19	.03	0.51	.20	59	13
1978	5.6	1.3	0.09	.06	0.28	.09	0.09	.02	0.38	.16	46	11
MIDDLE ISLAND, LAKE ERIE												
1974	5.6	1.6	0.32	.17	0.34	.14	0.38	.12	0.44	.43	72	14
1975	6.9	1.7	0.10	.07	0.28	.17	0.23	.09	0.22	.06	71	13
1977	7.4	2.2	0.05	.03	0.31	.09	0.19	.06	0.39	.34	78	24
1978	3.0	1.0	0.05	.03	0.21	.06	0.09	.03	0.02	.05	42	11
SNAKE ISLAND, LAKE ONTARIO												
1974	21	9.1	1.0	1.1	0.47	.25	0.56	.39	6.6	2.8	140	49
1975	24	6.1	0.23	.17	0.35	.20	0.22	.20	6.0	2.3	180	51
1977	17	4.7	0.11	.06	0.50	.10	0.50	.11	2.9	1.1	120	33
1978	10	1.6	0.07	.02	0.28	.10	0.35	.12	1.7	0.51	46	11
MUGG ISLAND, LAKE ONTARIO												
1974[2]	23	5.5	1.2	.79	0.46	.13	0.60	.36	7.4	4.7	170	48
1975	22	4.4	0.13	.06	0.24	.16	0.45	.26	3.4	1.4	110	21
1977	13	2.5	0.12	.05	0.27	.08	0.34	.06	2.1	0.4	87	19
1978[3]	11	3.0	0.10	.05	0.25	.06	0.28	.06	1.4	0.7	75	17

[1]10 eggs sampled per colony
[2]9 eggs sampled per colony
[3]8 eggs sampled per colony
S.D. - Standard Deviation

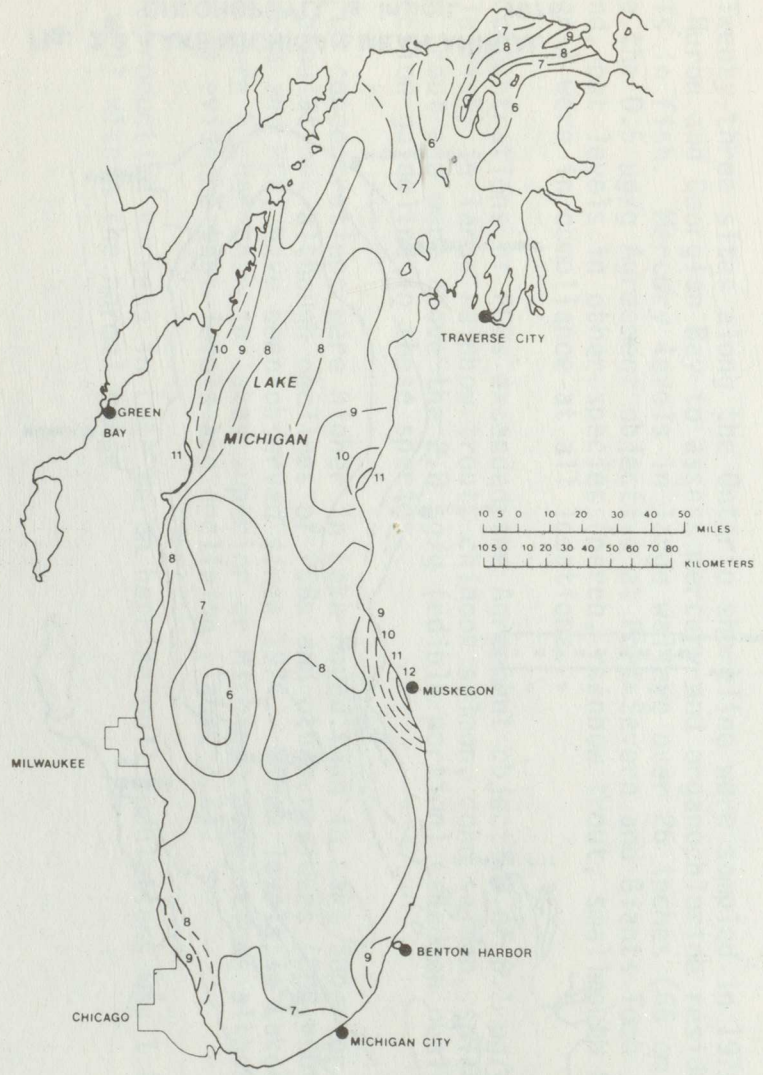
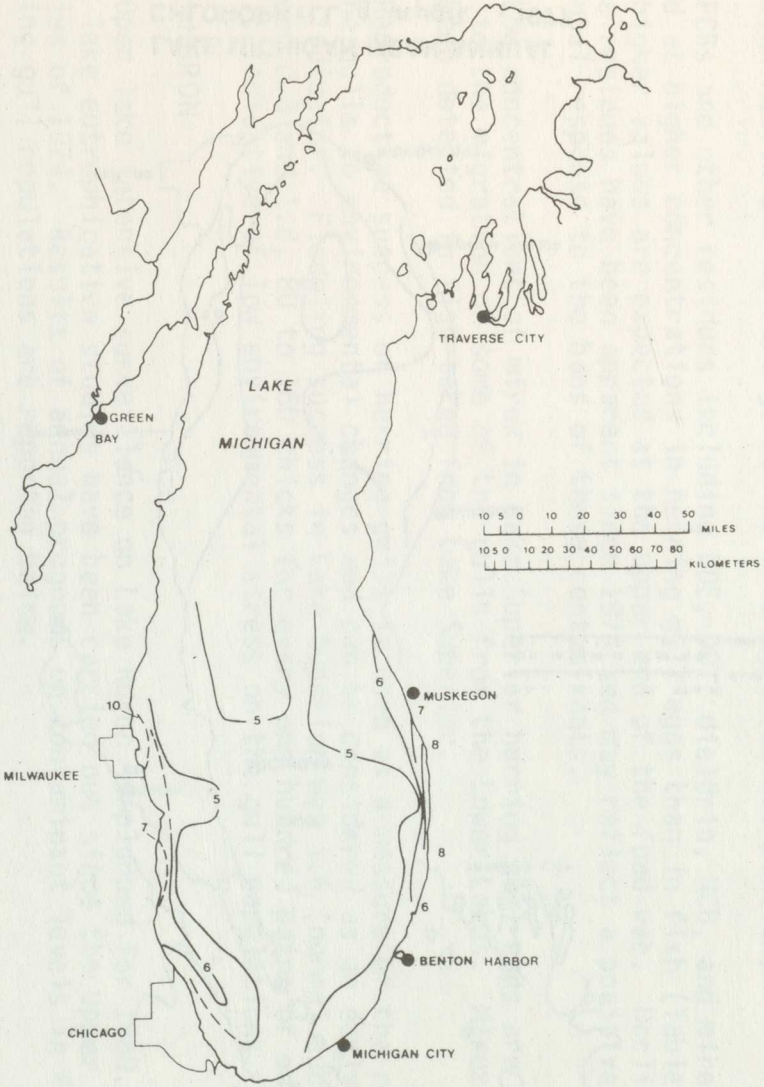


Fig. 2.2 LAKE MICHIGAN MEAN ANNUAL TOTAL PHOSPHORUS (P) DISTRIBUTION in µg/L - 1976



LAKE MICHIGAN MEAN ANNUAL TOTAL PHOSPHORUS (P) DISTRIBUTION in µg/L - 1977

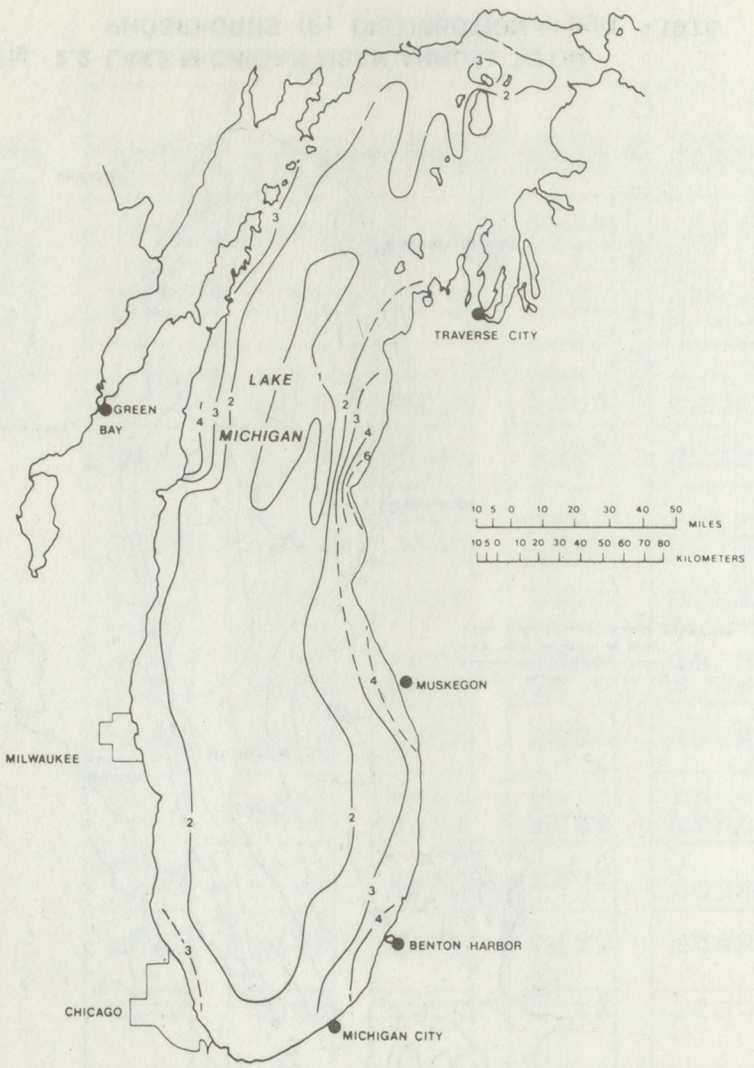
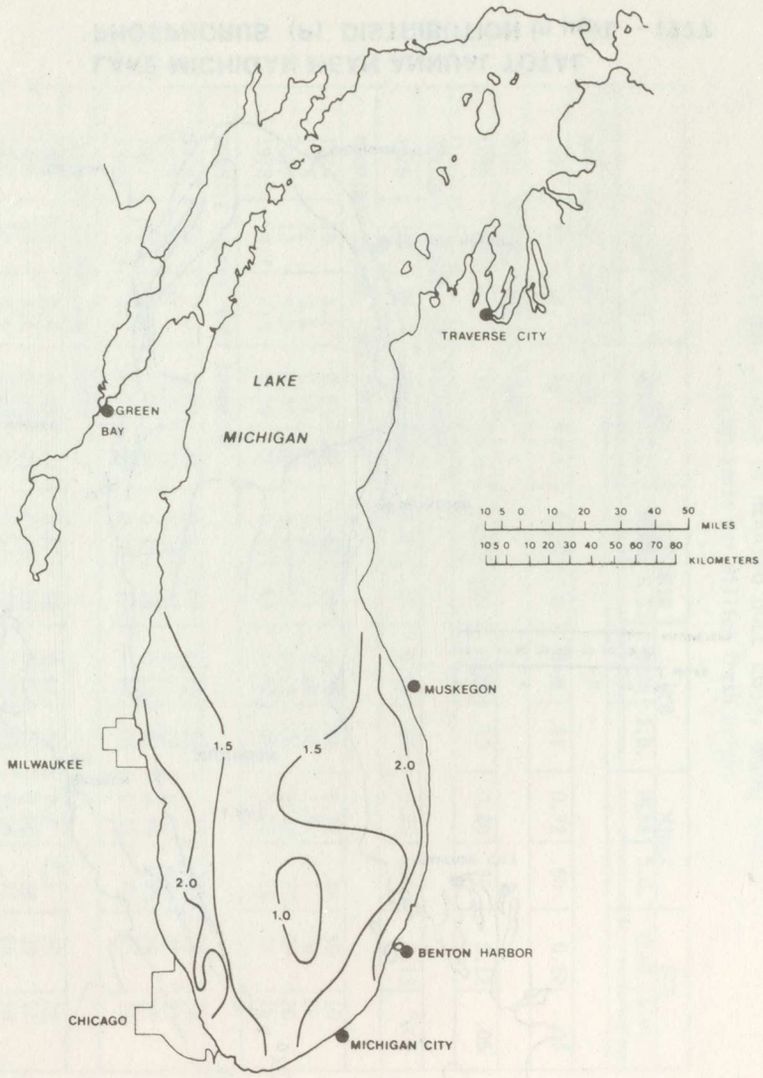


Fig. 2.3 LAKE MICHIGAN MEAN ANNUAL CHLOROPHYLL a in µg/L - 1976



LAKE MICHIGAN MEAN ANNUAL CHLOROPHYLL a in µg/L - 1977

Concentrations of PCBs in the same fish from these areas were above the 0.1 µg/g whole fish Agreement objective. Highest levels were observed in the larger fish over eighteen inches (45 cm) with residue levels exceeding the Canadian Health and Welfare guideline of 2 µg/g (edible portion).

PCBs and other residues including DDE, DDT, dieldrin, HCB, and mirex were found at higher concentrations in herring gull eggs than in fish (Table 2.2). The higher values are expected at the upper end of the food web. Declines in these residues have been apparent since 1974 and may reflect a positive environmental response to the bans of these contaminants.

Low concentrations of mirex in Lake Superior herring gull eggs are attributed to the migration of some of the gulls from the Lower Lakes. Mirex has not been detected in fish taken from Lake Superior.

Reproductive success of herring gulls is used as a measure of the response of the gulls to environmental changes and can be considered as an early warning indicator. Fledgling success in Lake Superior was 1.6 (normal success is between 0.8 and 1.6, 80 to 160 chicks for every one hundred pairs of adults) and is indicative of low environmental stress on the gull populations.

LAKE HURON

Open lake intensive surveillance on Lake Huron is planned for 1980. No open lake eutrophication studies have been carried out since the Upper Lakes studies of 1974. Results of annual programs on contaminant levels in fish and herring gull populations are reported below.

CONTAMINANTS

Twenty-three sites along the Ontario shoreline were sampled in 1978 on Lake Huron and Georgian Bay to assess mercury and organochlorine residue levels in fish. Mercury levels in large walleye over 26 inches (66 cm) were above the 0.5 µg/g Agreement objective at Port Severn and Giants Tomb Island, but levels in other species (perch, rainbow trout, smallmouth bass, suckers) were in compliance at all locations.

Concentrations of PCBs exceeded the Agreement objective of 0.1 µg/g (whole fish) in large rainbow trout, chinook salmon, coho salmon, splake, and brown trout and were above the 2.0 µg/g (edible portion) Canadian health protection guideline in these species.

PCB concentrations were higher in Lake Huron than in Lake Superior herring gull populations although declines of PCBs and other residues (DDE, DDT, dieldrin and HCB) have been observed since 1974. Mirex levels in Lake Huron gulls were higher than in lakes Superior or Michigan populations although there is evidence that levels are declining (Table 2.2).

Reproductive success in Lake Huron herring gull populations was 1.4 to 1.6, well within the normal range.

LAKE ERIE

1978 was the first year of a two-year intensive effort on Lake Erie in accordance with the nine-year framework of GLISP. Most of the data collected remains to be analyzed but preliminary observations are summarized below.

CONTAMINANTS

Declines of mercury concentrations in Lake St. Clair fish have continued. Most small fish (5 inches or 12 cm) are suitable for unrestricted human consumption (less than 1.0 µg/g). Mercury levels in yellow pickerel and white bass from the western basin have not changed significantly from those reported in 1977. They still exceed the 1978 Agreement objective of 0.5 µg/g.

Mercury levels detected in Lake Erie fish have declined since source control was initiated (Table 2.1).

Total mercury concentrations in the waters along the south shore of the eastern basin frequently exceeded the Agreement objective (0.2 µg/L) and values up to 6.1 µg/L were reported off Presque Isle. Elevated levels were also observed off Erie and Dunkirk.

PCB and dieldrin concentrations in fish are reported in Table 2.1. Dieldrin levels in coho salmon were below the whole fish Agreement objective.

Contaminant residues in Lake Erie herring gull eggs are declining (Table 2.2) with dieldrin illustrating the smallest change. The persistence of dieldrin in both fish and herring gulls indicates that it will require an extremely long time period before levels approach nondetectability.

Herring gull reproductive success was normal (1.5 fledgling success). Other contaminants analyzed for, but not found, were polynuclear aromatic hydrocarbons (more than 2 rings), chlorinated dioxins, and dibenzofurans. All these compounds were below the 10 µg/kg detection limit, though they may be present in smaller concentrations.

Lead levels in herring gull eggs from Lake Erie were 0.55 µg/g and were higher than levels of 0.41 and 0.36 µg/g observed in lakes Huron and Superior, respectively. Further investigation of the lead species will be performed in 1979 to determine the percentage of bioaccumulatable organic lead.

EUTROPHICATION

Preliminary results of the intensive study in 1978 have indicated no change in the trophic status of Lake Erie. Phosphorus concentrations near major tributaries are illustrated in Figure 2.4. Nearshore chlorophyll *a* levels reflect the open lake condition except in local areas such as Presque Isle Bay, Maumee Bay and Brest Bay where concentrations over 100 µg/L were recorded.

Results of open lake surveys indicated no change in phosphorus concentrations or chlorophyll *a* levels since 1970. In 1978, the summer mean total phosphorus levels were 14.2 µg/L and 13.1 µg/L in the central and eastern basins, respectively.

Volumetric oxygen depletion rates in the central basin have not changed since 1970 (Table 2.3) confirming the conclusion that the overall eutrophic status of the lake has not changed.

Scientists have different opinions on the reasons for the low dissolved oxygen in the Lake Erie central basin. Some attribute this phenomenon to the recent influence of man in the form of increased phosphorus discharges. Another group views the problem as an ongoing situation that has not changed appreciably over the past 20 or 30 years. These theories are being reviewed by the Phosphorus Management Strategies Task Force.

LAKE ONTARIO

Annual surveillance programs are performed on Lake Ontario because its position at the downstream end of the Great Lakes System makes it more susceptible to eutrophication and contamination. A summary of 1978 data from open lake monitoring and contaminant surveys is presented below.

CONTAMINANTS

PCB levels in open lake and nearshore fish samples exceeded the Canada Health and Welfare guideline of 2 µg/g in large (more than 22 inches) coho salmon, chinook, and rainbow trout (Table 2.1).

Mirex contamination has been found primarily in Lake Ontario. Levels in the fish species studied ranged between 0.06 and 0.32 µg/g. Much higher mirex levels were observed in herring gull eggs (1.4 µg/g) but these levels have declined since 1974. The decrease of mirex in herring gulls might reflect the reduced contaminants load to Lake Ontario.

Levels of PCBs have also declined in herring gull eggs (Table 2.2), as have levels of DDE, DDT, dieldrin, and HCBs. Associated with these declines has been a distinct increase in reproductive success from 0.15 in 1974 to 1.01 in 1978. Although the effects of contaminants on reproductive success is not fully understood, the present findings are encouraging.

EUTROPHICATION

Total phosphorus levels continued to decline between 1977 and 1978 with the major decline being east of Toronto (Figure 2.5). The decrease between 1970 and 1978 in whole lake total phosphorus levels is significant. The decrease might result in part from the settling of particulates during the winter ice cover.

Levels of nitrate-nitrite continued to increase as reported last year, but the increase between 1977 and 1978 was less than rates previously observed.

Large declines of total phosphorus and chlorophyll *a* levels occurred in the Bay of Quinte during 1976 and 1978. This decline is attributed to phosphorus removal programs at all sewage treatment plants discharging to the Bay and to the lower precipitation observed in 1978.

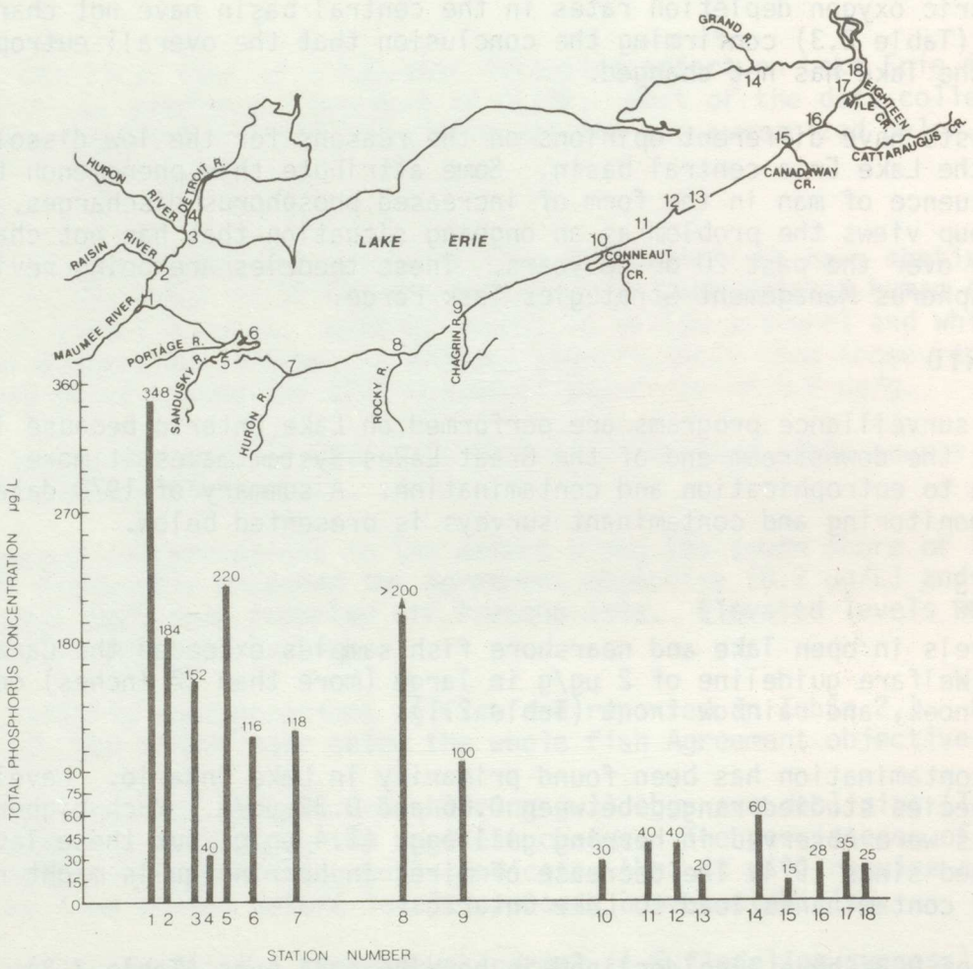


Fig. 2.4 TOTAL PHOSPHORUS CONCENTRATION AT MAJOR TRIBUTARIES IN LAKE ERIE, 1978

TABLE 2.3

TRENDS IN NET OXYGEN DEMAND OF THE CENTRAL BASIN HYPOLIMNION OF LAKE ERIE, 1930-1978

(Rate per unit volume - mg O_2/L/d)

YEAR	CENTRAL BASIN	YEAR	CENTRAL BASIN
1930	0.054	1973	0.12
1940	0.067	1974	0.13
1950	0.070	1975	0.10
1960	0.093	1976	0.13
1970	0.13	1977	0.13
		1978	0.11

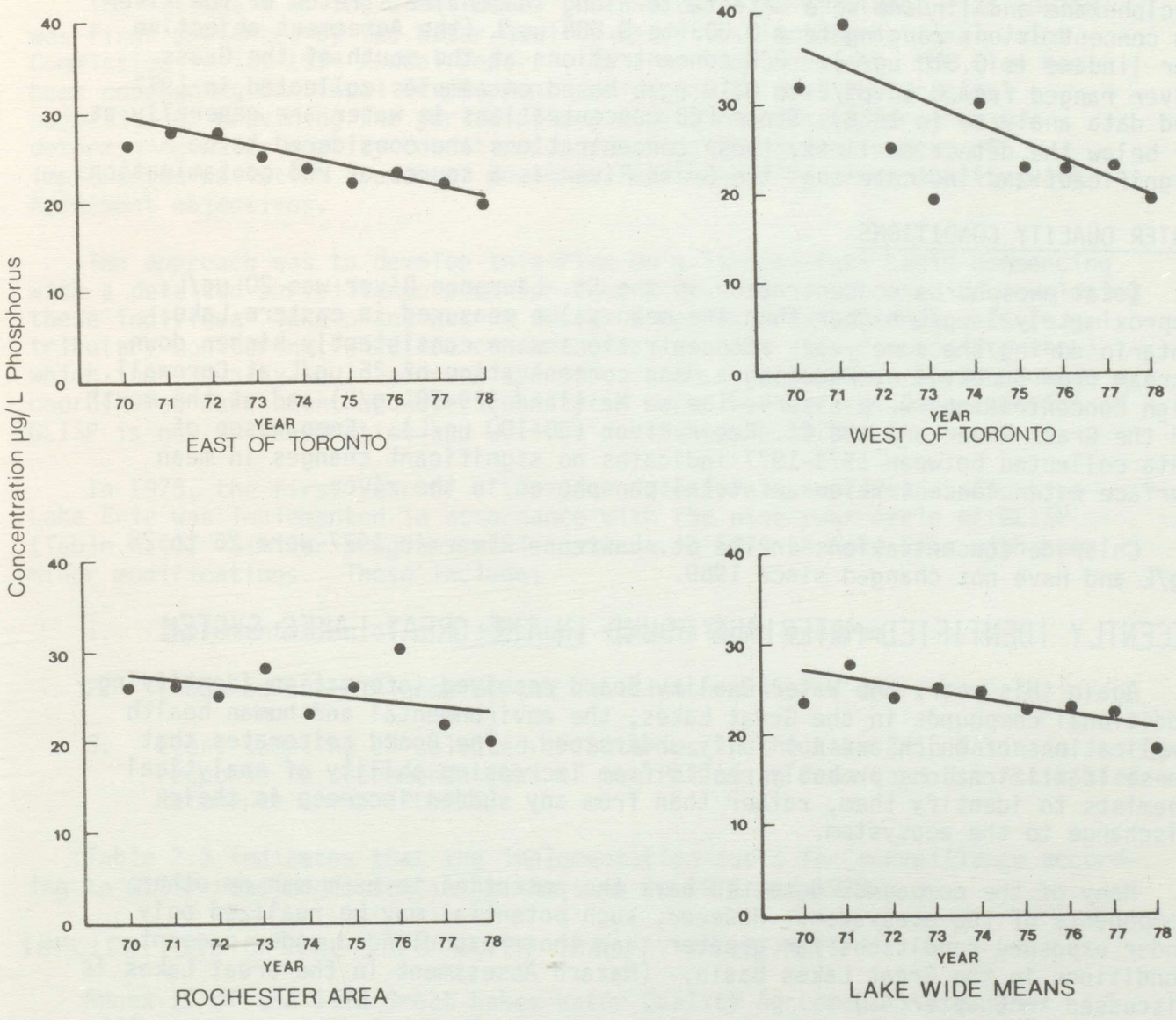


Fig. 2.5 SPRING MEAN OF TOTAL PHOSPHORUS IN LAKE ONTARIO

ST. LAWRENCE RIVER

CONTAMINANTS

Water samples were collected from the St. Lawrence River in June and August (1977) for the analysis of persistent organic contaminants. Hexachlorocyclohexane and lindane were detectable along the entire stretch of the river in concentrations ranging from 0.003 to 0.008 µg/L (the Agreement objective for lindane is 0.010 µg/L). PCB concentrations at the mouth of the Grass River ranged from 0.06 µg/L to 0.18 µg/L based on samples collected in 1977 and data analyzed in 1978. Since PCB concentrations in water are generally at or below the detection limit, these concentrations are considered to be significant and indicate that the Grass River is a source of PCB contamination.

WATER QUALITY CONDITIONS

Total phosphorus concentration in the St. Lawrence River was 20 µg/L, approximately 3 µg/L higher than the mean value measured in eastern Lake Ontario during the same year. Concentrations were consistently higher downstream from Brockville, reaching a mean concentration of 25 µg/L at Cornwall. High concentrations were observed below Maitland (29-50 µg/L) and at the mouth of the Grass River and the St. Regis River (30-100 µg/L). Comparison of data collected between 1973-1977 indicates no significant changes in mean surface water concentrations of total phosphorus in the river.

Chloride concentrations in the St. Lawrence River in 1977 were 26 to 28 mg/L and have not changed since 1969.

RECENTLY IDENTIFIED MATERIALS FOUND IN THE GREAT LAKES SYSTEM

Again this year, the Water Quality Board received information identifying additional compounds in the Great Lakes, the environmental and human health implications of which are not fully understood. The Board reiterates that these identifications probably result from increasing ability of analytical chemists to identify them, rather than from any sudden increase in their discharge to the ecosystem.

Many of the compounds detected have the potential to harm man or other components of the ecosystem. However, such potential may be realized only under exposure conditions far greater than those experienced under present conditions in the Great Lakes Basin. (Hazard Assessment in the Great Lakes is discussed in Chapter 4.)

Compounds detected in herring gull eggs from Lake Erie in 1978 and which have not previously been reported by the Board include tri-, tetra-, penta-, and hexachlorinated terphenyls.

Polychlorinated terphenyls (PCTs) with concentrations in the low parts per million range (1-3 µg/g) have been found in Lake Erie herring gull eggs collected from Fighting Island and Middle Sister Island in the western basin. The environmental properties of PCTs are expected to be similar to those of PCBs. These industrial chemicals have similar uses in heat exchangers, capacitors, and hydraulic transmission fluids. Industrial production of terphenyls was suspended in 1971.

Levels of dioxin in Saginaw Bay ranged from 10 to 1,000 pg/g (parts per trillion), and in Lake Ontario, ranged from 4.6 to 6.5 pg/g. Further assessments of these concentrations and their environmental implications are required.

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN

The rationale of the Great Lakes International Surveillance Plan (GLISP) was first presented by the Water Quality Board to the International Joint Commission in its 1974 Annual Report. As a working document, the Plan has been undergoing continual development and review to meet the original objective of providing the jurisdictions with a coordinated program for determining water quality conditions, assessing the effectiveness of implemented pollution abatement measures, and comparing water quality with Agreement objectives.

The approach was to develop this Plan on a lake-by-lake basis commencing with a detailed surveillance plan for Lake Erie. The format used in developing these individual lake plans was to design a series of plan components (e.g. tributary monitoring, wildlife contaminants, problem area assessment, etc.) which individually would address specific issues but together would provide a coordinated assessment of water quality in each lake basin. Documentation of GLISP is now in preparation and will be published in 1979.

In 1978, the first year of a two-year intensive surveillance effort on Lake Erie was implemented in accordance with the nine-year cycle of GLISP (Table 2.4). Similar programs will continue in 1979 on Lake Erie with some minor modifications. These include:

1. Implementation of a Cladophora surveillance program;

2. Enhanced surveillance of the Canadian nearshore; and

3. Event sampling on selected tributaries in the Lake Erie Basin in response to recommendations of the Pollution from Land Use Activities Reference Group (PLUARG).

Table 2.5 indicates that the implementation costs for surveillance according to GLISP remained essentially the same in 1978 and 1979.

IMPLICATIONS OF THE 1978 WATER QUALITY AGREEMENT

Annex 11 of the 1978 Great Lakes Water Quality Agreement states that surveillance and monitoring activities shall be undertaken for the following purposes:

(a) Compliance assessment;

(b) Assessment of water quality in terms of the general and specific objectives of the 1978 Agreement;

(c) Evaluation of water quality trends, and

(d) Identification of emerging problems.

With the increasing emphasis on toxic substances, the number of specific water quality objectives has increased from 8 to 41. Most of these are organic substances which are costly to measure in biological tissue and water. The development of new and improved analytical methods will be required in some cases so these substances can be measured on a routine basis. The capacity of most analytical laboratories participating in the surveillance program is already over-burdened and expansion is limited by the availability of skilled operators.

The substantial increase in the number of contaminants requiring examination now and in the future necessitates special vigilance to ensure that new analytical methods are carefully documented, that interlaboratory comparisons are conducted, and that data banks are readily accessible.

Evaluations of the Canadian and United States surveillance programs in the Great Lakes are presently being conducted by both countries. Results will be available in 1979.

PROBLEM AREAS

The term problem area was initially used by the Water Quality Board in 1975 to indicate localities in the Great Lakes where field measurements show degraded water quality. The basis for these determinations was the specific water quality objectives in the 1972 Agreement or the general objectives as expressed by jurisdictional standards or criteria. The 1972 Agreement objectives did not contain the specific objectives for toxic substances referenced in the 1978 Agreement.

The Water Quality Board recognizes three categories of problem areas.

1. An area where water quality objectives have not been achieved because remedial programs are not yet completed.

2. An area where remedial programs have been completed, but a delay is expected before conditions in the lake show improvement.

3. An area where further remedial programs may be required.

With these considerations, the Water Quality Board has identified 48 problem areas in the Great Lakes Basin (Table 2.5). Of these, twenty-six problem areas were classified as category 1, six as category 2, and sixteen as category 3. The locations of these problem areas are illustrated in Figure 2.6. Compliance of the dischargers with domestic enforcement programs is also shown on Table 2.6 with an assessment by the jurisdiction of whether or not completion of these remedial programs will result in compliance with Agreement objectives.

New problem areas have been identified in Lake Ontario, at Clarkson in Mississauga, Ontario, where high phenol concentrations (16 µg/L) have been observed near the Gulf Oil of Canada outfall; and in the St. Lawrence, at the mouth of the Grass River, New York, where high PCB levels have been reported.

In the Lake Erie Basin, the Pine River in Michigan, which was identified as a source of fecal coliform to the St. Clair River, has been dropped from the problem area list. Surveillance activities during 1978 found no coliform violations in the St. Clair River at the mouth of the Pine River.

TABLE 2.4

SURVEILLANCE SCHEDULE

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Lake Michigan	X	X			N			N		X
Lake Erie	A	A	X	X	A	A	A	A	A	A
Lake Huron					X					
Lake Ontario	A	A	A	A	A	X	X	A	A	A
Lake Superior								X		
Problem Areas	A	A	A	A	A	A	A	A	A	A

X - Denotes intensive survey of the entire lake.
A - Denotes annual routine monitoring of open lake and nearshore.
N - Triannual nearshore.

TABLE 2.5

GREAT LAKES SURVEILLANCE COSTS*

(Comparison of 1978 and 1979 Expenditures by Jurisdictions)

JURISDICTIONS	THOUSANDS OF DOLLARS	
	1978	1979
U.S. EPA	3,560.0	3,376.
U.S. F&WS	160.0	160.
CANADA	2,671.0	2,447.8
ONTARIO	2,045.0	2,590.0
MINNESOTA	11.0	25.0
WISCONSIN	84.0	87.1
INDIANA	200.0	200.00
MICHIGAN	485.0	564.1
OHIO	80.0	80.
PENNSYLVANIA	29.0	31.
NEW YORK	130.0	250.0
TOTAL	9,455.0	9,811.0

*These costs are those associated with GLISP and do not necessarily represent all expenditures by jurisdictions for environmental studies in the Basin.

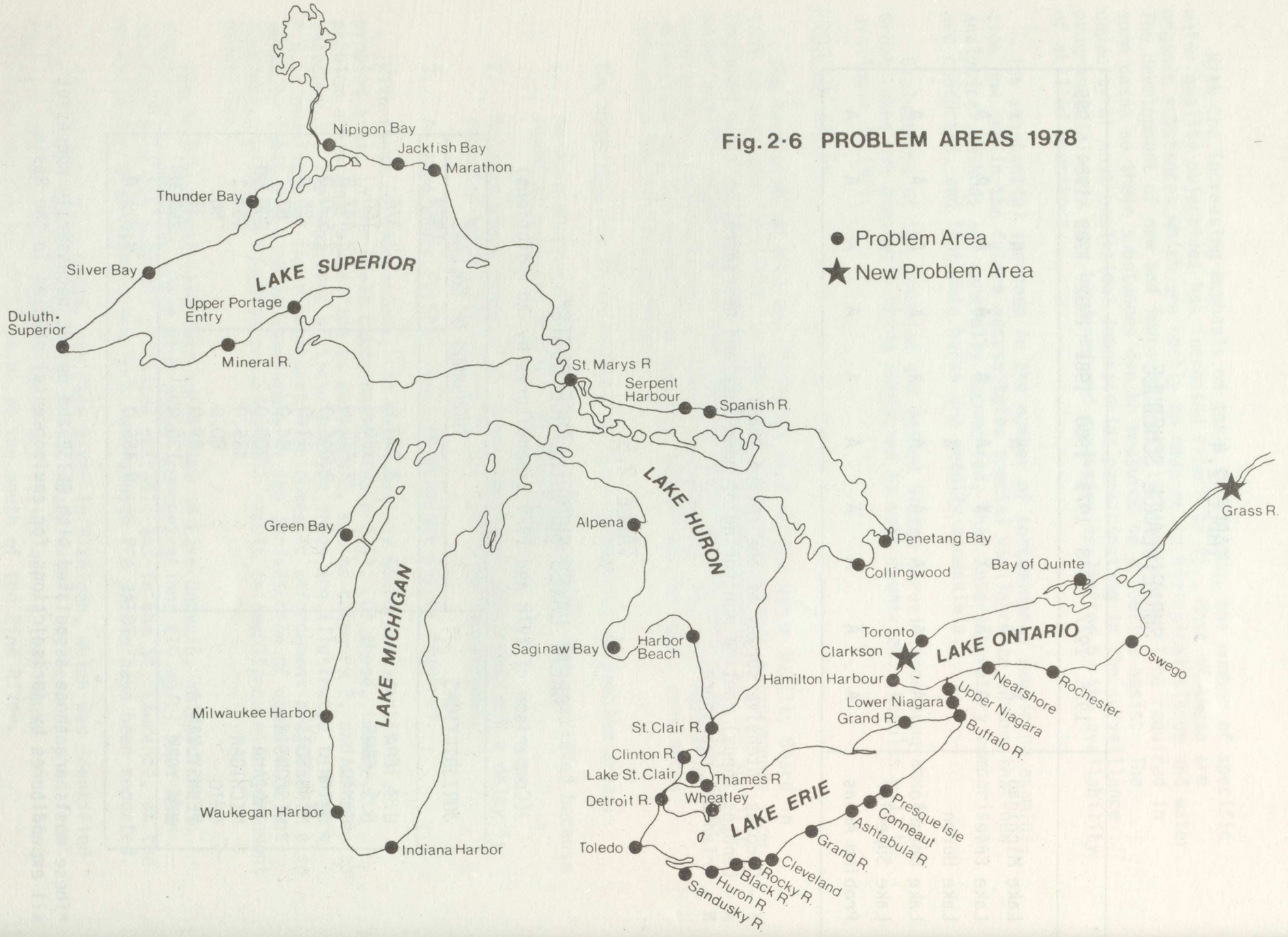


Fig. 2·6 PROBLEM AREAS 1978
Problem Area
New Problem Area
Nipigon Bay
Jackfish Bay
Marathon
Thunder Bay
Silver Bay
LAKE SUPERIOR
Upper Portage Entry
Duluth-Superior
Mineral R.
St. Marys R
Serpent Harbour
Spanish R.
LAKE HURON
Green Bay
Alpena
Penetang Bay
Collingwood
Bay of Quinte
Grass R.
LAKE MICHIGAN
Saginaw Bay
Harbor Beach
Toronto
Clarkson
LAKE ONTARIO
Oswego
Hamilton Harbour
Nearshore
Rochester
Lower Niagara
Upper Niagara
Grand R.
Buffalo R.
Milwaukee Harbor
St. Clair R.
Clinton R.
Lake St. Clair
Thames R
Detroit R.
Wheatley
LAKE ERIE
Presque Isle
Conneaut
Ashtabula R.
Waukegan Harbor
Grand R.
Toledo
Cleveland
Rocky R.
Black R.
Huron R.
Sandusky R.
Indiana Harbor

TABLE 2.6 PROBLEM AREAS - LAKE SUPERIOR

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
JACKFISH BAY [2]	Fish tainting and toxics.	1975	Kimberly Clark of Canada Ltd., Terrace Bay	Ontario	Probable source of tainting and toxics.	Met effluent requirements. New Mill start up in 1978.	Yes.
NIPIGON BAY [3]	Fish tainting and toxics.	1975	Domtar Packaging, Red Rock	Ontario	Probable source of tainting and toxics.	Met effluent requirements. Further reduction in toxicity under review.	Yes.
THUNDER BAY [1]	Dissolved oxygen, coliforms, phenol.	1977	Northern Wood Preservers, Ltd., Thunder Bay	Ontario	A probable source of phenol.	Acceptable phenol treatment in place.	Yes.
			Great Lakes Paper Co., Thunder Bay	Ontario	Source of BOD.	Did not meet effluent requirements. On schedule with approved closed-cycle system in full operation, application of same system to be made to old Kraft Mill.	Yes. But needs to be verified by field surveys.
			Industrial Grain Products Ltd., Thunder Bay	Ontario	Source of BOD.	Did not meet effluent requirements. Control order pending for pretreatment project before discharge to municipal sewer.	Yes. But needs to be verified by field surveys.
			Abitibi Paper Co. Ltd., Thunder Bay (3 mills: Fort William, Thunder Bay, Provincial)	Ontario	Source of BOD.	Did not meet effluent requirements. On schedule with control order. Projects at 3 mills to be completed by 1982.	Yes. But needs to be verified by field surveys.
			Canada Malting Ltd., Thunder Bay	Ontario	Source of BOD.	Began discharge to municipal sewer October 1978.	Yes. But needs to be verified by field surveys.
			Thunder Bay STP	Ontario	Source of BOD and coliforms.	Met effluent requirements. New wastewater treatment plant in operation April 1978.	Yes. But needs to be verified by field surveys.
	Mercury in sediments and fish.		Dow Chemical	Ontario	Past source of mercury.	Mercury process plant closed in 1973.	Yes. Over long term.

1. An area where water quality objectives have not been achieved because remedial programs are not yet completed.
2. An area where remedial programs have been completed, but a delay is expected before conditions in the lake show improvement.
3. An area where further remedial programs may be required.

TABLE 2.6 PROBLEM AREAS - LAKE SUPERIOR

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
MARATHON - PENINSULA HARBOUR [1]	Tainting, toxicity, mercury in fish.	1977	American Can of Canada Ltd., Marathon	Ontario	Source of tainting and toxicity.	Did not meet effluent requirements. On schedule with required program - expected completion 1980. Met 1977 requirement to cease mercury discharge.	Yes.
SILVER BAY [1]	Suspended solids. Includes asbestos fibres and turbidity.	1977	Reserve Mining Co., Silver Bay	Minnesota	Source of suspended solids.	Did not meet effluent requirements. On-land disposal system is under construction. Federal District court ordered completion by Apr. 15/80.	Yes.
DULUTH - SUPERIOR HARBOR [3]	Phosphorus, iron, coliform, total dissolved solids, dissolved oxygen.	1978	Western Superior San.Dist., (WLSSD) Duluth	Minnesota	Source of BOD, coliform, phosphorus.	Met effluent requirements. New plant completed November 1978.	Yes.
			WLSSD Cloquet	Minnesota	Source of BOD, coliform, phosphorus.	Met effluent requirements. Connected to WLSSD December 1978.	Yes.
			Conwed Corp., Cloquet	Minnesota	Source of BOD, phosphorus.	Met effluent requirements. Connected to WLSSD January 1979.	Yes.
			U.S. Steel Corp.. (Duluth Works), Duluth	Minnesota	Source of BOD, phosphorus, total dissolved solids.	Met effluent requirements. Treatment facilities construction completed. Ammonia quench waters recycled. Sanitary waters diverted to WLSSD sewer system. Coke operation will be shut down by 1981.	Yes.
			Potlatch Corp., Cloquet	Minnesota	Source of BOD.	Met effluent requirements. Connected to WLSSD January 1979.	Yes.
(cont'd)			Continental Oil Co., Duluth	Minnesota	Source of BOD.	Met effluent requirements. Connected to WLSSD December 1978.	Yes.

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3. An area where further remedial programs may be required.

TABLE 2.6 PROBLEM AREAS - LAKE SUPERIOR

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
DULUTH-SUPERIOR HARBOR (cont'd) [3]			Superior Fibre Prod. Inc., Superior	Wisconsin	Source of BOD.	Met effluent requirements. Wet process hardboard internal recycle and settling lagoons for blowdowns.	Yes.
			Superior STP	Wisconsin	Source of BOD, phosphorus, coliform.	Met effluent requirements. Phosphorus removal facilities satisfactory since May 1978. Satellite treatment plants for handling overflows operational in December 1978. Sewer renovations did not completely correct sewage overflows.	Yes.
MINERAL RIVER [3]	Total dissolved solids.	1977	White Pine Copper Co., White Pine	Michigan	Source of total dissolved solids.	Met effluent requirements.	Problem area being reassessed.
UPPER PORTAGE ENTRY [3]	Copper and zinc in sediments.	1976	Historical mining operation	Michigan	Mine tailings containing copper and zinc.	No remedial programs deemed feasible.	

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3. An area where further remedial programs may be required.

TABLE 2.6 PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
SAGINAW BAY [1]	Total dissolved solids, phosphorus, eutrophication.	1978	Alma STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Bay City STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Bridgeport Twp STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Buena Vista Twp STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Combined sewer overflows	Michigan	Source of total dissolved solids.	-	Combined sewer overflows may continue to cause problems during rainfall periods.
			Dow Chem., Bay City	Michigan	Source of solids.	Met effluent requirements.	Yes, over a long period of time.
			Dow Chem., Midland	Michigan	Probable source of total dissolved solids.	Met effluent requirements. $15.37 \times 10^3 m^3/d$ is being discharged via deep disposal wells.	Yes, over a long period of time.
			Flint STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Notice of violation issued.	Yes, over a long period of time.
			Flushing STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Midland STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
(cont'd)			Monitor Sugar Co., Bay City	Michigan	Source of solids.	Did not meet effluent requirements. Revised permit and final order on public notice.	Yes, over a long period of time.

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TABLE 2.6 PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
SAGINAW BAY [1] (cont'd)			Mt. Pleasant STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Failed to start construction Apr. 1978.	Yes, over a long period of time.
			Owosso STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Not in compliance due to construction delay caused by local court action which has been resolved.	Yes, over a long period of time.
			Saginaw STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Saginaw Twp. Sewage District	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Velsicol Chem. Corp., St. Louis	Michigan	Source of total dissolved solids, phosphorus.	Met effluent requirements.	Yes, over a long period of time.
ALPENA- THUNDER BAY [2]	Suspended solids.	1975	Abitibi Corp., Alpena	Michigan	Source of suspended solids.	Met effluent requirements.	Yes.
HARBOR BEACH [2]	Suspended solids.	1975	Hercules Inc., Harbor Beach	Michigan	Source of suspended solids.	Did not meet effluent requirements.	Yes.
COLLINGWOOD HARBOUR [1]	Nuisance algae.	1978	Collingwood STP	Ontario	Source of phosphorus.	Did not meet effluent requirements. Expansion and improved treatment under design. Operation expected by 1981.	Expect gradual improvement will result from phosphorus control.

1. An area where water quality objectives have not been achieved because remedial programs are not yet completed.
2. An area where remedial programs have been completed, but a delay is expected before conditions in the lake show improvement.
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TABLE 2.6 PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
PENETANG BAY [2]	Eutrophication.	1978	Penetanguishene STP	Ontario	Source of phosphorus.	Met effluent requirements.	Expect gradual improvement will result from phosphorus control.
SPANISH RIVER [1]	Fish tainting.	1977	E.B. Eddy Forest Products, Espanola	Ontario	Source of fish tainting.	Did not meet effluent requirements. On schedule with control order. Final phase of measures to reduce BOD and toxicity expected to be completed in late 1985.	Yes.
SERPENT HARBOUR [1]	Radium (^{226}Ra), pH.	1978	Denison Mines Ltd., and Rio Algom Mines, Serpent Harbour	Ontario	Source elevated levels of ^{226}Ra.	Did not meet effluent requirements. Requirement & Directions issued in 1977 for all active and idle mining properties requiring treatment of waste and drainage for removal of radium, heavy metals, nitrates, and stabilization of tailings systems.	Yes. However, long retention time of lakes in Serpent River system will delay achievement of objectives.
ST. MARYS RIVER [1]	Total coliform, phenols, and ammonia.	1978	Sault Ste. Marie STP	Ontario	Probable source of coliform. Source of ammonia.	Met effluent requirements. Program for sewage collection system improvements and treatment modifications to include phosphorus removal adopted recently by City.	Yes.
			Algoma Steel, Sault Ste. Marie	Ontario	Major source of phenols.	Did not meet effluent requirements. By-product recovery plant completed. Plant components being brought into operation, although operating problems have developed. A control order served in June 78 requires further improvements to meet effluent limitations.	Yes.

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3. An area where further remedial programs may be required.

TABLE 2.6 PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
GREEN BAY [1]	Dissolved oxygen, phosphorus, suspended solids.	1977	Wisc. Pub. Service (J.P.Pulliam Plt), Green Bay	Wisconsin	Source of suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Wisc. Tissue Mills, Menasha	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Nicolet Paper Co., W. DePere	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Riverside Paper Co., Appleton	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Midtec Paper Corp., Kimberley	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Hammermill Paper Co., Kaukauna	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Kimberley Clark Corp., Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Kimberley Clark Corp. (Lakeview Mill) Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Cons. Paper, Appleton	Wisconsin	Source of BOD, suspended solids.	Did not meet effluent requirements.	Yes.
(cont'd)			Bergstrom Paper Co., Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.

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TABLE 2.6 PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
GREEN BAY [1] (cont'd)			Ripon STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Heart of the Valley STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Oshkosh STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Appleton STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Appleton Papers, Combined Locks	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			American Can Co., Green Bay	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Fort Howard Paper, Green Bay	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			De Pere STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Menasha Twp. West STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Menasha Twp. East STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Neenah-Menasha Sewage Commission, Menasha STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements. Problem with industrial discharges of suspended solids.	Yes.

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TABLE 2.6 PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
MILWAUKEE [1] HARBOR	Suspended solids, coliform, dissolved oxygen.	1977	Sewage and storm water overflows	Wisconsin	Sources of BOD, suspended solids, coliform.	Court established schedules for operation of control facilities and correction of problem in 1990.	Yes.
WAUKEGAN [1] HARBOR	PCB in sediment.	1979	Outboard Marine, Waukegan	Illinois	Probable source of PCBs. Loss of PCBs from the sediments is a matter presently in litigation.	NPDES Permit imposing no discharge of PCBs is being challenged by discharger. Presently under litigation for past discharges resulting in PCB contamination of bottom sediments and water in Waukegan Harbor.	Both U.S. EPA and the State are involved in an enforcement action against Outboard Marine which is currently before Federal Dist. Court. Technical investigation is being conducted regarding the extent of contamination and remedial effort warranted.
INDIANA HARBOR [1]	Ammonia, phenols.	1977	East Chicago STP	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Enforcement action pending.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Gary STP	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Consent order requires full secondary treatment by Apr. 79. Operation and maintenance problems continue.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Hammond STP	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Energy Coop, East Chicago	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Hearing held and order pending.	Yes.
			Youngstown Sheet & Tube, East Chicago	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.
			American Oil Company, Whiting	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.
(cont'd)							

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TABLE 2.6 PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
INDIANA HARBOR [1] (cont'd)			U.S. Steel, Gary	Indiana	Source of ammonia, phenols.	Met effluent requirements. Final limits to be attained 1980.	Yes.
			Inland Steel, East Chicago	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.

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TABLE 2.6 PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
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ST. CLAIR [1] RIVER	Tainting of fish, toxic substances. Note: Dissolved organic discharges from all municipal and industrial sources along St. Clair River under study to establish by 1979 significance of tainting and toxic compounds. Remedial program requirements will be established based on results of study.	1977	CIL, Courtright	Ontario	Source of ammonia.	Met effluent requirements.	Yes.
			Ethyl Corp., Corunna	Ontario	Source of lead.	Met effluent requirements.	Yes.
			Esso Chemical, Sarnia	Ontario	Source of organics and phenols.	Did not meet effluent requirements. Approved program for reduction of dissolved organics, phenols completed.	Yes.
			Imperial Oil, Sarnia	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements.	Yes.
			Shell, Corunna	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements. Proceeding with agreed program to further reduce suspended solids.	Yes.
			Polysar, Sarnia	Ontario	Source of organics, phenols and ammonia.	Did not meet effluent requirements. On schedule with required program. Stage 1 - program completion 1978. Stage 2 requires further study.	Yes.
			Dow Chemical, Sarnia	Ontario	Source of organics and ammonia.	Met effluent requirements. Chlorine recycling proceeding. Company voluntarily seeking further reduction in chlorine.	Yes.
			Sun Oil, Sarnia	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements.	Yes.
THAMES RIVER [3]	Total dissolved solids.	1975	Upstream drainage	Ontario	Sources not identified.	-	-
LAKE ST. CLAIR [2]	Mercury in fish and sediment.	1976	-	Ontario	-	Discharges of mercury from the Sarnia area were discontinued in 1970.	Yes.
WHEATLEY [1] HARBOUR	Coliform, dissolved oxygen.	1978	Omstead Foods Ltd., Wheatley	Ontario	Probable source of BOD.	Did not meet effluent requirements. Facility installed in Sept. 1977; performance to be evaluated in 1979.	Yes.

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DETROIT RIVER [1]	Coliform, phenols, iron, total dissolved solids.	1978	Detroit STP	Michigan	Source of coliform, phenols, total dissolved solids, phosphorus.	Did not meet effluent requirements. The City is presently under a Consent Judgement which outlines effluent quality requirements. These become increasingly more stringent until Dec. 31/81 when full secondary capacity with phosphorus removal is mandated.	Yes.
			Ford Motor Co., Rouge Complex, Dearborn	Michigan	Source of phenols, iron.	Did not meet effluent requirements. Notices of violation issued.	Yes.
			Gt. Lakes Steel, National Steel (4 plants), River Rouge & Ecorse	Michigan	Source of phenols, iron.	Did not meet effluent requirements. Notices of violation issued.	Yes.
			Pennwalt Corp., East & West Plants, Wyandotte	Michigan	Source of total dissolved solids, iron, phenols.	Did not meet effluent requirements. Referral to State Attorney General.	Yes.
			Trenton STP	Michigan	Source of coliform, phosphorus.	Did not meet effluent requirements. Notice of noncompliance issued.	Yes.
			Wayne County STP, Wyandotte	Michigan	Source of coliform, phosphorus.	Did not meet effluent requirements. Notice of noncompliance issued.	Yes.
(cont'd)			Wayne County STP, Trenton	Michigan	Source of coliform, phosphorus.	Met effluent requirements.	Yes.

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DETROIT RIVER [1] (cont'd)			Combined sewer overflows	Michigan	Source of coliform, total dissolved solids.	-	Combined sewer overflows may continue to cause problems during rainfall periods.
			BASF Wyandotte Corp., North & South Works, Wyandotte	Michigan	Source of total dissolved solids.	Did not meet effluent requirements. Complaint filed in State Court Sept. 9/78.	Yes.
			BASF Wyandotte Corp., Fighting Island	Ontario	Source of total dissolved solids.	Met effluent requirements.	No economic technology available for further reduction of dissolved solids.
			Allied Chemical Canada Ltd., Amherstburg	Ontario	Source of total dissolved solids.	Met effluent requirements.	No economic technology available for further reduction of dissolved solids.
			Amherstburg STP	Ontario	Source of phosphorus, coliform.	Did not meet effluent requirements. Sewage treatment improvements under review.	Yes.
			Belle River STP	Ontario	Source of coliform, phosphorus.	Met effluent requirements.	Yes.
			Canadian Salt Co. Ltd., Windsor	Ontario	Source of total dissolved solids.	Met effluent requirements.	Yes.
(cont'd)			Chrysler Canada Ltd., Windsor	Ontario	Source of solids.	Met effluent requirements.	Yes.

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DETROIT RIVER [1] (cont'd)							
			Ford Motor Co. Ltd., Windsor	Ontario	Source of phenols, total dissolved solids, iron.	Met effluent requirements.	Yes.
			Windsor-Little River STP	Ontario	Source of solids, coliform, phosphorus.	Met effluent requirements.	Yes.
			Windsor Westerly STP	Ontario	Source of coliform, phosphorus.	Met effluent requirements. Plant expansion scheduled for completion in 1982.	Yes.
CLINTON [1] RIVER	Fecal coliform, total dissolved solids.	1977	General Electric, Warren	Michigan	Source of dissolved solids.	Met effluent requirements.	Problem area being reassessed.
		1977	Mt. Clemens STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Rochester STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Pontiac STP	Michigan	Source of coliform.	Met effluent requirements.	Problem area being reassessed.
		1977	Warren STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Combined sewer overflows	Michigan	Source of coliform.	Interceptor collapsed, discharged to river during 1978. Now repaired.	Combined sewer overflows may continue to cause problems during rainfall periods.
TOLEDO AREA [1]	Algae, coliform, dissolved oxygen.	1978	Toledo STP	Ohio	Major point source of BOD, phosphorus, coliform.	Did not meet effluent requirements.	Upstream nonpoint sources and combined sewer overflows will continue to to cause problems.
GRAND RIVER [3]	Total dissolved solids.	1978	Upstream drainage	Ontario	Source of dissolved solids.	No remedial program planned.	-

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CLEVELAND [1] AREA	Dissolved oxygen, coliform, phenols, heavy metals, fluoride, MBAS.	1977	Cleveland Electric Illuminating, Cleveland	Ohio	Source of heavy metals.	Did not meet effluent requirements. Permit conditions being contested.	Yes.
			Dupont DeNemours, Cleveland	Ohio	Source of metals, ammonia.	Met effluent requirements. Permit conditions being contested.	Yes.
			Republic Steel, Cleveland	Ohio	Source of metals, phenols, ammonia.	Met effluent requirements. Permit conditions being contested.	Yes.
			Jones & Laughlin, Cleveland	Ohio	Source of phenols, metals, ammonia, cyanides.	Met effluent requirements. Permit conditions being contested.	Yes.
			Harshaw Chemical, Cleveland	Ohio	Source of heavy metals, ammonia.	Met effluent requirements.	Yes.
			Cleveland Regional Sewerage Dist. Easterly STP, Cleveland	Ohio	Source of BOD, phosphorus, coliform.	Met effluent requirements. Plant currently being upgraded. Completion date, 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
			Cleveland Regional Sewerage Dist. Southerly STP, Cleveland	Ohio	Major source of BOD, phosphorus, coliform, ammonia.	Did not meet effluent requirements. Being upgraded. Construction completion 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
(cont'd)			Cleveland Regional Sewerage Dist. Westerly STP, Cleveland	Ohio	Source of BOD, phosphorus, coliform.	Did not meet effluent requirements. Treatment construction completion expected 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.

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CLEVELAND AREA [1] (cont'd)			Akron STP	Ohio	Source of BOD, phosphorus, coliform.	Did not meet effluent requirements. State warning issued.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
			U.S. Steel, Cleveland	Ohio	Source of metals.	Met effluent requirements. Ceased discharging Oct. 78.	Yes.
SANDUSKY [3] RIVER	Algae, coliform, dissolved oxygen, copper.	1978	Fremont STP	Ohio	Major source of BOD, phosphorus, coliform.	Met effluent requirements.	Upstream nonpoint sources and combined sewer overflows will continue to cause problems.
HURON RIVER [1]	Total organic nitrogen, chemical oxygen demand, manganese, arsenic.	1978	Huron STP	Ohio	Source of BOD, nitrogen.	Met effluent requirements. Will be upgraded to secondary treatment.	Yes.
BLACK RIVER [3]	Coliform, ammonia, dissolved oxygen, phenol, metals.	1978	U.S. Steel, Lorain	Ohio	Major source of ammonia, phenol.	Did not meet effluent requirements.	Yes.
			Lorain STP	Ohio	Major source of BOD, phosphorus.	Did not meet effluent requirements.	Nonpoint sources, stormwater and combined sewer overflows may still cause problems.
			Elyria STP	Ohio	Secondary source of BOD, phosphorus.	Did not meet effluent requirements. State warning sent.	Nonpoint sources, stormwater and combined sewer overflows may still cause problems.
GRAND RIVER [3]	Total dissolved solids, phenols.	1975	-	Ohio	-	-	-
CONNEAUT [2] RIVER	Dissolved oxygen, total dissolved solids, iron, zinc.	1978	Conneaut STP	Ohio	Source of BOD, iron, zinc.	Met effluent requirements.	Yes.

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ROCKY RIVER [3]	Coliform, dissolved oxygen, ammonia.	1978	Lakewood STP	Ohio	Source of BOD, coliform ammonia.	Met effluent requirements.	Yes.
			Rocky River STP	Ohio	Source of BOD, coliform, ammonia.	Met effluent requirements.	Yes.
			Combined sewer overflows	Ohio	Source of BOD, coliform.	-	Combined sewer overflows continue to cause problems.
ASHTABULA [1] RIVER	Chloride, total dissolved solids, iron, zinc, copper, lead.	1978	RMI, Ashtabula	Ohio	Source of total dissolved solids, chlorine.	Did not meet effluent requirements.	Yes.
			Ashtabula STP	Ohio	Source of metals.	Did not meet effluent requirements. Pre-treatment is planned for industries discharging to municipal sewers.	Yes.
			Union Carbide, Ashtabula	Ohio	Source of dissolved solids and metals.	Met effluent requirements.	Yes.
PRESQUE [1] ISLE BAY	Dissolved oxygen, coliform.	1978	Combined sewer overflows	Pennsylvania	Source of BOD, coliform.	Bond issue floated by City of Erie to resolve portions of problem.	No, only a portion thereof, phased program to correct problems dependent upon availability of funds.

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TABLE 2.6 PROBLEM AREAS - LAKE ONTARIO

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
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BUFFALO RIVER [3]	Coliform. Note: Industries are listed because of phenol discharges which contribute to the Niagara River water quality problems.	1977	Mobil Oil Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Will eventually discharge to municipal system.	Yes.
			Republic Steel Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Adjudicatory hearing held. ECSL issued. New compliance date-April 1980.	Yes.
			Buffalo Color Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Remedial facilities have been completed.	Yes.
			Donner-Hanna Coke Corp., Buffalo	New York	Source of phenols.	Met effluent requirements.	Yes.
			Bethlehem Steel, Hamburg	New York	Source of phenols.	Met effluent requirements.	Yes.
			Buffalo, Combined sewer overflows	New York	Probable source of phenols. Source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
UPPER [3] NIAGARA RIVER (cont'd)	Coliform, phenols. Note: Problem area is affected by discharges to the Buffalo River.	1977	Buffalo S.A. STP	New York	Source of coliform.	Met effluent requirements. New secondary plant under construction. Expected completion Sept. 1979.	Yes.
			Tonawanda (T) STP #2	New York	Source of coliform.	Met effluent requirements. New secondary facility completed and in operation August 1978.	Yes.
			Tonawanda (C) STP	New York	Source of coliform.	Connected to Tonawanda (T) STP January 1979.	Yes.

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UPPER NIAGARA RIVER (cont'd) [3]			Grand Island Biological Co., Six Mile Cr.	New York	Source of phenols.	Met effluent requirements.	Yes.
			General Motors Corp., Chevrolet Motor Div., Tonawanda	New York	Source of phenols.	Met effluent requirements.	Yes.
			Hooker Chemical & Plastics Corp., Niagara Falls	New York	Source of phenols.	Met effluent requirements. Discharge permit was modified in late 1977 which significantly reduced effluent limits for halogenated organics, added a new limit for mirex and required that a detailed monitoring program be conducted to identify quantities and source of additional substances.	Yes.
			Allied Chemical Corp., Semet-Solvay, Tonawanda	New York	Source of phenols.	Met effluent requirements.	Yes.
			National Steel Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. ECSL issued compliance date September 1979.	Yes.
			Ashland Oil Inc., Tonawanda	New York	Source of phenols.	Met effluent requirements. To connect to municipality.	Yes.
			Buffalo, Combined sewer overflow	New York	Probable source of phenols; source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.

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LOWER [1] NIAGARA RIVER	Coliform, phenols. Note: Problem area is affected by discharges to the Buffalo and Upper Niagara Rivers.	1977	Lewiston STP	New York	Source of coliform.	Connected to Lewiston Master Sewer Improvement Area January, 1979.	Yes.
			Niagara Falls STP	New York	Source of coliform.	Did not meet effluent requirements. New facility experiencing operational problems due to industrial waste and excess flows. To be fully operational by 1980.	Yes.
			Niagara Falls, Combined sewer overflows	New York	Source of coliform; probable source of phenols.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
			Stamford Niagara Falls STP	Ontario	Probable source of coliform.	Met effluent requirements. Expansion to 12.5 MIGD under construction for future growth of municipality. Fully operational by 1980.	Yes.
LAKE ONTARIO [3] SHORELINE FROM MOUTH OF NIAGARA RIVER TO 18 MILE CREEK	Total coliform.	1976	Municipal discharges to the Niagara River are contributing to water quality problems along the Lake Ontario shoreline.	New York, Ontario	Source of coliform.	Direct discharges from municipal treatment plants in Niagara-on-the-Lake and 2 plants in St. Catharines are satisfactory.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
MISSISSAUGA-[1] CLARKSON AREA	Phenols.	1978	Gulf Oil Ltd., Mississauga	Ontario	Source of phenols.	Did not meet effluent requirements.	Possible modification of present remedial program under investigation.

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ROCHESTER [3] EMBAYMENT	Coliform.	1977	Irondequoit STP	New York	Source of coliform.	Being served by Rochester Frank Van Lare STP. Phased out October, 1978.	Yes.
			Rochester, Frank Van Lare STP	New York	Source of coliform.	Met effluent requirements.	Yes.
			Rochester, Combined sewer overflows	New York	Source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
OSWEGO HARBOR [3]	Chloride, nitrate.	1977	Oswego East Side STP	New York	Probable source of chloride, nitrate.	Met effluent requirements. Requested 301(i) extension to prepare industrial waste ordinance.	Yes.
			Oswego West Side STP	New York	Probable source of chloride, nitrate.	Secondary facilities completed late 1978.	Yes.
			Miller Brewing Co., Oswego	New York	Probable source of nitrate.	Met effluent requirements.	Yes.
			Osewgo, Combined sewer overflows	New York	Probable source of chloride, nitrate.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
			Natural drainage	New York	Source of chloride, nitrate.	Natural geological conditions and land runoff from the Seneca-Oneida-Oswego River Basin.	Natural conditions are the primary cause of problems.
TORONTO [1] HARBOUR & WATERFRONT	Coliform, algae.	1978	Combined sewer overflows	Ontario	Source of BOD, phosphorus.	Completion of automated interceptor controls expected in 1980 when plant is completed.	Yes.

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HAMILTON HARBOUR [1]	Iron, algae, coliform, dissolved oxygen.	1978	Hamilton STP	Ontario	Source of coliform, phosphorus.	Did not meet effluent requirements. Facility expansion completed Jul. 79.	Yes.
			Stelco, Hamilton	Ontario	Source of iron, phosphorus, BOD.	Did not meet effluent requirements. Not on schedule with agreed program. Start up of filtration plant delayed till 1979.	Yes.
			Dofasco, Hamilton	Ontario	Source of iron, phosphorus, BOD.	Did not meet effluent requirements. On schedule with agreed program. Studies underway to expand hot mill filtration plant.	Yes.
			Dundas STP	Ontario	Probable source of coliform, BOD, phosphorus.	Met effluent requirements. Plant expansion to 18,000 m3/d completed in 1978.	Yes.
BAY OF QUINTE/ ADOLPHUS BEACH [1]	Algae, dissolved oxygen.	1978	Domtar Packaging, Trenton	Ontario	Source of BOD, phosphorus.	Did not meet effluent requirements. On schedule with agreed program. High phenols under investigation.	Yes.
			Trent Valley Paperboard, Glen Miller	Ontario	Source of BOD, phosphorus.	Met effluent requirements.	Yes.
			Belleville STP	Ontario	Source of BOD, phosphorus.	Met effluent requirements. Gradual improvement is expected as a result of phosphorus control and facility expansion completed in 1979.	Yes.
GRASS RIVER [3] (St. Lawrence River)	PCBs.	1977	Under investi-gation.	New York	PCBs.	Ban use of PCBs.	-

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3. An area where further remedial programs may be required.

3 REGULATORY AND REMEDIAL PROGRAMS

The Great Lakes Water Quality Agreement requires the development of remedial programs and other measures to prevent or reduce the input of pollutants to the Great Lakes System and compatible regulatory requirements in both the United States and Canada directed towards achievement of the water quality objectives.

Canadian and American approaches to environmental problems are similar as the two countries share environmental goals. However, different rates of industrial development, different socio-economic conditions, and different constitutional frameworks can result in different strategies for similar problems.

The logic of approaching environmental problems in different ways was recognized and accepted in the 1972 and 1978 Canada-United States Great Lakes Water Quality Agreements. Both countries adopted common objectives for water quality improvement recognizing that these objectives could be attained through compatible domestic policies and programs which would not necessarily be identical.

Any valid comparison or evaluation of Canadian-United States environmental legislation must consider the end result; that is, how close each has come to achieving the common goals or objectives.

In accordance with the 1972 Agreement requirements, programs have emphasized control of conventional pollutants from point sources and considerable progress has been made to reduce the discharge of these substances to the environment. The 1978 Agreement and new legislation place added emphasis on the control of toxic substances and pollution from nonpoint sources. The discussions in this report are in response to Commission questions on programs and relate to both the conventional pollutants and the developing programs on toxic substances.

REGULATORY PROGRAMS

UNITED STATES

The Clean Water Act is the basic legislation for water pollution control in the United States. Previous Water Quality Board reports have traced the evolution of United States water pollution law through its major revision in 1972 and the most recent amendments.

The Clean Water Act and implementing regulations set forth a control program called NPDES (National Pollutant Discharge Elimination System). Effluent limits and abatement schedules are imposed through permits. The program's strengths are in its attention to the detailed performance of each permittee and in the enforceability of permit limitations. Discharge permits are issued to all point source dischargers regardless of size. Limits are based on

effluent guidelines, best professional judgement, or water quality standards whichever is most stringent. Violations of permit limits and abatement schedules are subject to substantial penalties as well as administrative enforcement action.

Virtually all major dischargers were issued permits in the period 1974 - 1975. A compliance tracking system was begun at that time to determine violators for enforcement action. The program has resulted in impressive pollution load reductions in the Great Lakes Basin, particularly for industrial dischargers. The success of the program is based on a high rate of voluntary compliance by the dischargers and a significant resource commitment by state and federal agencies to impose administrative remedies (notice of violation, and orders, etc.) where compliance does not proceed on schedule.

Among the most troublesome items in industrial permit development are the delays in effluent guideline development occasioned by lawsuits filed by industry, and the long proceedings needed to adjudicate permits opposed by industry. The greatest problem in enforcement for municipal and industrial dischargers is the difficulty that the Environmental Protection Agency (EPA) and the states have had in rectifying violations of schedules or limits when administrative remedies fail. The court actions relied on by the agencies in such circumstances are decisive but they are slow and resource intensive. As a result, some violators receive inadequate enforcement attention.

EPA and the states need to improve their followup system on violators. It would be useful if EPA had the power to levy administrative fines commensurate with the costs industry saved through the delay. Some of the states have administrative authority to assess fines or receive payments to some degree and are, as a result, able to avoid lengthy court proceedings in some situations.

CANADA

In Canada, the implementation of pollution control is a cooperative federal-provincial endeavour. Under the federal Fisheries Act, national guidelines and regulations are developed to control water pollution from specific industrial sectors. Industrial guidelines, which do not have legal status, indicate minimum acceptable national standards of practice for existing plants. Regulations, which are legally enforceable, prescribe specific national effluent limitations for new and expanding plants for various industrial sectors, with the exception of regulations for chlor-alkali plants applicable to both existing and new facilities.

Under a federal-provincial accord, Ontario has agreed to adopt pollution control requirements at least as stringent as the national requirements described above. Where local conditions necessitate, more stringent requirements are imposed by the provincial government.

Under provincial legislation (detailed in previous Water Quality Board reports), the Ontario Ministry of Environment employs a variety of measures to encourage compliance with its requirements. These range from voluntary measures through formal programs and control orders, to prosecution as necessary. They provide a degree of flexibility which enables consideration of

local circumstances, while still meeting the province's environmental objectives. These administrative measures are not solely dependent upon rigid legal processes which may result in unnecessary and often time consuming court actions, and have been employed successfully in pollution abatement throughout the province. New or expanded facilities must receive a certificate of approval before work begins.

Control orders are used when substantial time and effort may be required to abate pollution. The orders, which are legally enforceable, define tasks and compliance dates by which specific tasks leading to abatement must be completed. Failure to meet these dates can lead to prosecution. The government regards the control order procedure to be an effective device which can be employed under the Ontario Environmental Protection Act, the Ontario Pesticides Act, and the Ontario Water Resources Act.

A program of municipal sewage plant construction begun by the province in 1956 has progressively advanced to the point where, gradually, responsibility for new facility development is being turned over to municipal governments. Until recently, assistance to industry has been mainly through tax reductions. However, the province, in cooperation with the federal government, is currently offering a program of incentives to assist industry to both modernize and reduce pollution. Under this program, Canada and Ontario will provide approximately $150 million of direct financial assistance to correct pollution from the pulp and paper industry over the next five years. The program is expected to encourage compliance with objectives for environmental quality for each mill.

COMPLIANCE WITH DISCHARGE REQUIREMENTS IN 1978

A greater number of Canadian and United States dischargers were in compliance with the effluent requirements in 1978 than in 1977 (Table 3.1).

In the Great Lakes Basin, 71 percent of the 864 major dischargers in both countries were in compliance with their respective pollution control requirements in 1978 compared to 54 percent of the 824 reported in 1977.

Of the 864 industrial and municipal dischargers listed in the WQB's point source inventory, 447 of the United States and 171 of the Canadian dischargers met the effluent limitations imposed by pollution control agencies in 1978. The significant improvement in the status of compliance for the United States dischargers can be attributed to the 1978 achievement of the more stringent industrial requirements after July 1, 1977 and the completion during 1978 of municipal treatment plants that have been awaiting federal grant funding.

In Canada, continued upgrading of wastewater treatment facilities and emphasis on plant operations account for the improvements noted.

A higher rate of compliance basinwide would be expected if dischargers followed optimum operation and maintenance procedures to ensure that performance approached the design efficiency of the facilities and if programs were in effect to continually upgrade the skills of the operators.

It should be noted that dischargers reported as in compliance this year may be discharging toxic substances that are not within the current regulatory

TABLE 3.1
COMPLIANCE WITH DOMESTIC REQUIREMENTS OF DISCHARGERS IN THE GREAT LAKES SYSTEM DURING 1978

LAKE BASIN AND JURISDICTION	INDUSTRIES				MUNICIPALITIES**			
	Number Meeting Requirements		Number Not Meeting Requirements		Number Meeting Requirements		Number Not Meeting Requirements	
	1977	1978	1977	1978	1977	1978	1977	1978
SUPERIOR								
Ontario	3	6	7	4	3	4	3	1
Michigan	4	5	3	1	0	2	3	3
Minnesota	2	5	4	2	2	8	4	0
Wisconsin	4	4	0	0	0	1	2	1
MICHIGAN								
Illinois	4	1	0	0	1	0	0	1
Indiana	8	15	10	3	9	11	5	4
Michigan	42	44	12	14	14	15	18	19
Wisconsin	18	24	13	5	10	27	15	3
HURON								
Ontario	7	3	4	8	19	24	6	7
Michigan	17	19	6	3	8	9	5	8
ERIE								
Ontario	13	19	11	6	30	37	2	1
Indiana	1	2	2	1	2	2	2	2
Michigan	23	30	19	16	4	12	15	10
New York	3	3	4	1	5	9	6	1
Ohio	11	17	20	20	12	31	40	31
Pennsylvania	1	3	0	0	0	1	2	1
ONTARIO								
Ontario	15	18	28	24	48	46	18	5
New York	72	92	57	19	34	39	29	13
ST. LAWRENCE RIVER								
Ontario	*	3	*	5	*	11	*	1
New York	*	11	*	2	*	5	*	0
TOTAL								
Canada	38	49	50	47	100	122	29	15
United States	209	275	151	87	101	172	146	97
%								
Canada	43.2	50.+	56.8	49.+	77.5	89.1	22.5	10.9
United States	58.1	76.0	41.9	24.0	40.9	63.8	59.1	36.2

* - Included in Lake Ontario

** - Includes indirect STPs with flows equal to or greater than 3800 m^3/d and all direct dischargers.

TABLE 3.2

MAJOR LEGAL AND ENFORCEMENT ACTIONS DURING 1978

FACILITY OR DISCHARGER	DATE	ACTION
Scott Paper Oconto Falls, Wisconsin	1978	Grand jury investigating company's compliance with NPDES permit limitations.
	Jan. 1979	The company paid a settlement of $1,000,000 for NPDES permit limit violations and for noncompliance with NPDES July 1, 1977 requirements.
Niagara of Wisconsin Paper Corp. and Fort Howard Paper Company Wisconsin	June 1978	Wisconsin Supreme Court ruled that if state NPDES permit effluent limitations are not based upon federal guidelines, the limitations must be modified to conform with federal regulations.
Other Wisconsin Paper Mills		All the pulp and paper mills in the Lake Superior and the Lake Michigan basins are now in compliance with permit limits. However, legal actions are still being pursued because of prior discharge violations by the following mills in the Lake Michigan Basin: Badger Paper Mills on the Peshtigo River at Peshtigo; Bergstrom Paper Co. on the Fox River at Neenah; Consolidated Papers on the Fox River at Appleton; Midtec Paper Corp. on the Fox River at Kimberly; Niagara of Wisconsin on the Menominee River at Niagara.
Tecumseh Products Co., Sheboygan, Wisconsin	May 1978	Source of PCB contamination of Sheboygan River discovered. State issued order requiring company to perform testing to detect contaminated area, provide plan for removal and disposal of contaminated materials, and carry out the plan by July 1, 1979.
Ansul Company Marinette, Wisconsin	July 1978	Arsenic contamination of Menominee River. Company completes removal of arsenical solid wastes from their property. Wastes disposed of in approved chemical disposal area in Illinois. The company is under continuing state orders to monitor the groundwater and seek appropriate methods of removing the contamination from the affected soils and groundwaters.
Gary Sanitary District Gary, Indiana	Jan. 1978	United States Environmental Protection Agency (EPA) filed a complaint against the Sanitary District and the City of Gary for numerous NPDES permit violations and for improper operation and maintenance of the waste treatment plant.
	Jan. 1979	A consent preliminary order was entered into by the parties to bring the waste treatment plant into compliance with secondary standards by April 1, 1979.
	April 1979	Gary requested a 60-day extension on March 29, 1979 in federal court in Hammond and was rejected by the judge.
Outboard Marine Corp. (OMC) Waukegan, Illinois	March 1978	The company filed suit against United States EPA and the Illinois EPA claiming they were liable for the clean up of the PCBs for not having taken action under the Clean Water Act. United States EPA filed suit against the company claiming that the company was liable for clean up of the PCB contaminated sediment and soil and for performing a study of the environmental impact of the contamination.
	Aug. 1978	State of Illinois filed suit for the clean up of the PCB contaminated sediments and soil.
	Nov. 1978	The company joined the Monsanto Company as a defendant, claiming Monsanto was liable for any fines that OMC might have to pay since Monsanto provided the company with the PCB fluids that were subsequently released.
City of Detroit Michigan	July 1978	Deadline for city to attain interim effluent limits as specified in the September 1977 consent judgement.
	Sept. 1978	City submitted monitoring data for the period after the interim deadline.
	Nov. 1978	Hearing on an order to show cause why the city cannot come into immediate compliance with the consent judgement. The court appointed a federal monitor to observe operation of the plant for 30 days.

Table 3.2 cont'd.

FACILITY OR DISCHARGER	DATE	ACTION
City of Detroit Michigan (cont'd)	Dec. 1978	The monitor filed his report, citing numerous problems and violations of the consent judgement.
	Jan. 1979	The city filed an answer to the monitor's report. United States EPA filed a response to the city's answer citing the city's answer as inadequate. Hearing set for February, 1979 to decide future course of action.
	March 1979	The federal judge added to the powers of Mayor Coleman Young the extraordinary powers entrusted by the court. He is not responsible to the Water Board, the Civil Service Commission, local or state governments, but only to the court, in the operation of the Detroit Wastewater System.
BASF Wyandotte Wyandotte, Michigan	Sept. 1978	Permit conditions and settlement are being negotiated out of court. A consent court order is expected.
Michigan Chemical-Velsicol		State denied an extension of compliance and company shut down all operations in September and October 1978.
RMI Company Ashtabula, Ohio		The company has completed construction of facilities which it feels will meet the state effluent requirements, however, sufficient data have not been submitted to verify the adequacy of the operation. Also, RMI has appealed the proposed United States EPA effluent limits which were more stringent than the state limits. The case is still pending.
Olin Corporation Niagara Falls, New York	March 1978	The company and former officers of the company were indicted for submitting false NPDES effluent monitoring information and for NPDES permit violations most importantly concerning mercury discharges. Trial date set for July 1979.
Power Plant Intakes		Regulatory action was taken by United States agencies to minimize environmental impacts of intake structures. Agencies are requiring the installation or testing of fine mesh screening systems at a number of Great Lakes plants including Wisconsin Public Service Company Pulliam Plant, Consumer Power Co.'s Campbell Station, and Detroit Edison's Belle River power plant. A number of Lake Erie power plants in Ohio extended their intake monitoring programs at the request of United States agencies to implement studies on fish populations.
Reserve Mining Co., Silver Bay, Minnesota	April 1978	Under Federal District Court Order the company must cease discharge to the lake by April 1980. Under a state Supreme Court order, a permit was issued for construction and operation of an onland disposal system.
American Can of Canada Ltd. Marathon, Ontario	June 1978	An existing Requirement and Direction was amended with respect to suspended solids control. Domestic sewage is to be directed to the municipal system.
E.B. Eddy Forest Products Ltd. Espanola, Ontario	1978	A Control Order was issued with respect to suspended solids, BOD, and pH. It is expected that a modified bleaching process will achieve required BOD level by 1982.
Culverhouse Ltd. Vineland, Ontario	July 1978	A Control Order was issued requiring treatment to meet objectives or discharge to municipal system when available.
Cyanamid of Canada Ltd. Welland, Ontario	Feb. 1978	A comprehensive Control Order involving 12 stages was issued to achieve complete control by 1984.
Interflow Systems Ltd. Hamilton, Ontario	1978	A total of 138 charges have been laid for allegedly providing false information to the provincial environment ministry and improperly filling out shipping records. Now before the courts.

requirements. Future reports will more accurately assess compliance with the objectives of the 1978 Agreement.

A summary of major legal enforcement actions in both countries is given in Table 3.2. During 1978 major enforcement actions were taken against 15 dischargers in the United States and 5 in Canada.

MUNICIPAL ABATEMENT PROGRESS

TREATMENT OF MUNICIPAL WASTES

The United States and Canada have different but compatible approaches to fulfill the purpose of the Agreement and to meet the General and Specific Objectives. Both have programs for construction and operation of municipal waste facilities to provide "adequate treatment".

"Adequate treatment" in the United States Great Lakes Basin is defined as a minimum of secondary treatment with effluent concentrations of 30 mg/L for BOD and suspended solids and a total phosphorus concentration of 1.0 mg/L in the effluent. Advanced waste treatment is required if water quality standards are not met by secondary treatment.

In Canada, Ontario requires waste treatment to be adequate to prevent pollution of receiving waters. In general, "adequate treatment" is defined as a minimum of secondary treatment or equivalent with 20 mg/L BOD and suspended solids in the treated effluent. Higher levels of treatment are required if water quality cannot be maintained by biological secondary treatment with phosphorus control. Seventeen plants in the Lower Lakes Basin, where 1.0 mg/L total phosphorus or less is required, employ sedimentation with supplementary chemical treatment which is considered to be adequate to meet water quality objectives. Phosphorus removal programs in the Upper Lakes Basin are under current review in light of the requirements of the 1978 Agreement. Eighty-six percent of the municipal sewage flow from the 4.7 million sewered population in the Ontario portion of the drainage basin receives biological treatment.

As of December 31, 1978, 64 percent of the 1971 sewered population (15.3 million) of the Great Lakes Basin was provided with "adequate treatment" in the United States. This represents an increase of some 70,000 people over the past year. Completion of facilities under construction will raise the percent of sewered population with "adequate treatment" to 99 percent by 1983. On the Canadian side, the portion of sewered population served by "adequate treatment" was 99 percent as reported in the 1977 Annual Report.

EXPENDITURES

The levels of expenditures of funds committed to municipal project construction for both countries since 1971 are shown in Table 3.3.

MAJOR MUNICIPAL PROJECTS

Major municipal treatment plants with incomplete construction programs were listed in 1977. A review of the current status of construction (Table 3.4) shows that further delays have occurred at Detroit, Gary, and the three Cleveland plants (Easterly, Westerly, and Southerly). Facilities at Duluth,

TABLE 3.3
FUNDS COMMITTED FOR MUNICIPAL SEWERAGE CONSTRUCTION IN THE GREAT LAKES BASIN
(in millions of dollars)

YEAR	CAPITAL COMMITMENTS FOR SEWERAGE WORKS IN ONTARIO BY ALL LEVELS OF GOVERNMENT[1]	OBLIGATED STATE AND FEDERAL FUNDS IN THE UNITED STATES[2]
1971	57	370
1972	66	313
1973	138	419
1974	103	509
1975	112	950
1976	174	429
1977	150	716
1978	191	618
TOTAL	991	4,324

[1]Figures represent total capital commitments for treatment plants and interceptor sewers.

[2]Figures represent total United States eligible project costs with federal grant approval through December 31, 1978.

TABLE 3.4
CONSTRUCTION OF MAJOR MUNICIPAL PROJECTS
(As of January 1, 1979)

FACILITY	SEWERED POPULATION	ANTICIPATED COMPLETION DATES		COSTS TO COMPLETE CURRENT PROJECTS
		As Stated 1976 Report	Current Status	(Millions of Dollars)
UNITED STATES				
Detroit, Michigan	3,129,000	After 1980	Dec 31, 1981	482
Duluth, Minnesota				
Western Lake Superior Sanitary District	126,000	Nov. 1978	Operational	-
Gary, Indiana	175,400	1977	1982	76
Cleveland, Ohio				
Westerly	250,000	1981	1982	90
Easterly	700,000	1978	1982	45
Southerly	635,000	1981	1982	290
Tonawanda, New York				
Sanitary District #2	107,700	1978	Operational	-
Syracuse Metro, New York	287,600	June 1979	June 1979	108
Buffalo, New York	750,000	1979	1979	170
CANADA				
Thunder Bay	106,000	July 1977	Operational	-

Minnesota, Tonawanda, New York and Thunder Bay, Ontario were completed and put in operation in 1978. The current status of the major municipal sewage treatment plants listed in previous reports is as follows:

THUNDER BAY, ONTARIO

Construction of the new primary wastewater treatment plant was completed and the plant began operation in May 1978. The new plant was constructed on the site of the old North Plant and the South Plant was converted to a pumping station.

DULUTH (WLSSD), MINNESOTA

The new Western Lake Superior Sanitary District (WLSSD) Wastewater Treatment Facility was recently completed and became operational during December 1978. The new facility receives all municipal wastewaters from the Duluth area, replacing nine inadequate municipal wastewater facilities. In addition, the new facility receives wastewaters from all industrial sources including three major pulp and paper processing plants.

The WLSSD facility is a pure oxygen activated sludge process with phosphorus removal which will provide for effluent quality better than that defined for secondary treatment. The WLSSD facility provides for chlorination and dechlorination and discharges into Lake Superior. It is currently meeting all NPDES effluent limitations.

WLSSD's total concept approach to waste management combines advanced wastewater treatment and solid waste disposal in one sophisticated and innovative system. The solid waste processing includes: pit conveyers, coarse shredding, ferrous metal separation, fine shredding, air classification, ferrous metal and heavy fraction separation. The resulting light fraction is then conveyed to the fluidized bed reactor or a fuel storage silo for use as fuel for sludge incineration. The non-combustible residue is separated and landfilled or sold for scrap.

The sludge disposal facilities will be fueled by the prepared municipal refuse and the remaining ash will be disposed of by landfilling. The facilities are scheduled for completion in March 1979. At present all sludge is being disposed of by landfilling.

GARY, INDIANA

Although marginal secondary treatment with phosphorus removal was provided at the existing facility, total STP upgrading and expansion is being implemented. Pretreatment and enlargement of existing primary facilities are now 98 percent complete, and secondary treatment expansion is now 50 percent complete. Phosphorus removal facilities are complete and await the provision of the significant level of funding needed for operation. Advanced waste treatment for nitrification and facilities for sludge treatment are funded and construction will soon begin. When completed in 1982, advanced waste treatment will be applied. Legal actions are described earlier in the report.

DETROIT, MICHIGAN

On March 21, 1979, a federal judge appointed the Mayor of Detroit as Special Administrator to manage the operation of the Detroit Sewage Treatment

Plant. The Mayor will have complete control over the facility and will report only to the judge. This action was taken following a report presented to the court in December 1978 by an independent monitor. The report was highly critical of the facility's staff and management deficiencies of construction contracts.

The city is presently under a consent judgement which outlines effluent quality requirements and a schedule for completion and operation of facility components. The consent judgement outlines the requirements for construction and performance that are necessary to achieve the final goal of full secondary treatment with phosphorus removal by December 31, 1981.

The following major redesign and construction projects are underway, in addition to other contracts in various stages of completion:

(a) Final effluent plan including combined sewer overflow
(b) Solids handling
(c) Water systems
(d) Interim sludge disposal

TOLEDO, OHIO

The City of Toledo wastewater treatment facility is a conventional activated sludge plant with primary settling, final clarification, and phosphorus removal. Sludge is processed, vacuum filtered, and utilized on agricultural lands. A construction grant for the Ten Mile Creek Interceptor has been awarded. This is a long term, five-phase project with construction of Phase 1 anticipated to start in 1979.

Combined sewer overflows remain a problem in wet weather. To remedy this, the city has completed a facility plan (awaiting United States EPA approval) which evaluates the sewered service area and recommends how future interceptor construction and other conveyance and treatment remedial works can best be mounted to meet water quality goals and discharge requirements.

CLEVELAND, OHIO (WESTERLY)

Construction is generally on schedule for completion in 1982. When fully operational in 1983, this wastewater treatment plant will provide advanced waste treatment and will be able to provide full treatment to short term peak flows and partial treatment for storm flows. The new advanced wastewater treatment plant will provide lime clarification, ozonated carbon column treatment, pressure filtration, and phosphorus removal. Complete solids treatment and incineration will be provided. Also, detailed plans are in progress for storm water overflows which will permit more effective use of the completed Northwest Interceptor.

CLEVELAND, OHIO (EASTERLY)

The present conventional activated sludge wastewater treatment plant with phosphorus removal is currently being upgraded to provide improved secondary clarification, improved solids handling, chlorine contact tank, dechlorination capability, and a lift station which will make it possible to fully discharge

effluent during periods of high lake levels. The plant will be capable of treating short term peak flows. Improvements are scheduled to be completed in 1982 and the plant should be fully operational by early 1983.

CLEVELAND, OHIO (SOUTHERLY)

Construction is proceeding on schedule for upgrading the present conventional sludge wastewater treatment plant with phosphorus removal to a two-stage activated sludge system. When construction is completed in 1982 and the system fully operational in 1983, the present activated sludge system will become the first stage. The new construction will be the second stage. In addition, a complete solids treatment and incineration system will be provided.

An explosion on April 26, 1978 completely destroyed the blower building at the plant and thus eliminated all operations using compressed air. By June 22, the secondary treatment unit was placed back in service. During the down period of 56 days, approximately 6720 million gallons of wastewater received only primary treatment and disinfection.

Prior to the time of the explosion, monthly average effluent concentrations of phosphorus ranged from 1.9 to 3.5 mg/L P. After the explosion the average monthly concentration varied between 2.9 and 4.8 mg/L through the month of September and then ranged between 2.9 and 4.2 mg/L. The higher effluent concentration of P since resumption of the secondary treatment is due to inadequate sludge handling facilities. Measures to correct this problem are underway and are expected to be completed by August 1979.

EUCLID, OHIO

Construction of an advanced treatment plant has been completed. However, operational problems are being encountered and modifications in the system may be necessary.

LORAIN, OHIO

Lorain has resolved its sludge handling problem through negotiating a contract for land application of sludge. Since excessive sludge has severely affected the phosphorus removal operation, it is anticipated that, after three months of sludge removal under the new contract, the 1.0 mg/L phosphorus limit can be achieved (approximately July 1, 1979).

ERIE, PENNSYLVANIA

The Erie Sewer Authority Wastewater Treatment Plant was designed to provide secondary activated sludge treatment and phosphorus removal. It was expanded in 1973. Sludge handling capabilities were provided in 1974. Sludge is digested, conditioned, vacuum filtered, incinerated and disposed of in a landfill. An agreement was reached in 1975 with Hammermill Paper Company calling for treatment of wastewater from this industry. Subsequently, problems in achieving adequate design treatment have been encountered. These appear to result from a hydraulic and/or waste overload. Steps are being taken to identify how this overload can be corrected, including the possibility of plant enlargement and/or preclusion of further loading to the wastewater treatment plant.

NIAGARA FALLS, NEW YORK

The City of Niagara Falls has upgraded its facilities to provide complete secondary treatment plus phosphorus removal. This physical-chemical plant is designed to treat municipal/industrial wastewater using the carbon absorption process. The plant is substantially completed and received its first flow in April 1977. There are, however, problems that must be resolved before the plant can be considered fully operational.

In July 1978, it was determined that the corrosive nature of the wastewater caused structural damage to the carbon bed bottoms and backwash nozzles. Corrective measures have been initiated and it is anticipated that the carbon-bed filters will be back in full operation by late 1979 or early 1980. A few of the contributing industries have not yet installed adequate pretreatment facilities for the removal of constituents which are detrimental to the municipal treatment facility. As a result, a portion of the wastewater flow is bypassing the municipal treatment facility.

Excessive dry weather flows are being measured in the sewer system. A 1978 report entitled "Investigation and Measures for Flow Reduction and Water Pollution Control Program Completion" prepared for the City of Niagara Falls under a grant from the United States EPA is now under review by New York State Department of Environmental Conservation (NYSDEC) and United States EPA.

METROPOLITAN SYRACUSE, NEW YORK

The existing primary facility is being upgraded to an activated sludge STP with phosphorus removal. A new force main and pumping station are also being constructed to convey alkaline industrial waste from Allied Chemical Company. This will be used in the lime precipitation process for phosphorus removal. Construction of this advanced waste treatment facility began in 1975 and is approximately 95 percent complete. Final completion is scheduled for the summer of 1979.

As do many older cities, Metropolitan Syracuse has a problem with combined sewers. Combined sewer overflows to Onondaga Lake and its tributaries occur at approximately 90 locations. A survey is being conducted of the combined sewer overflows and should be completed by spring 1979.

TONAWANDA, NEW YORK (SANITARY DISTRICT NO. 2)

This plant is completed and has been in operation since August 1978.

BUFFALO, NEW YORK

The Buffalo Sewer Authority is upgrading its existing primary STP to an activated sludge facility with phosphorus removal. This plant is expected to be in operation in June 1979.

PHOSPHORUS CONTROL PROGRAMS

UPPER LAKES

The Water Quality Board recommended to the Commission in 1976 that the 1.0 mg/L limit for phosphorus from municipal plants be extended to the Upper

Lakes. In October 1977, the WQB modified this recommendation by stating that the 1.0 mg/L limit on municipal phosphorus discharge should apply to plants over 1 MGD for the Upper Lakes as it does for the Lower Lakes, and evaluations of phosphorus loads from smaller plants should be made as the program progresses. In lakes Superior and Huron, the states of Michigan, Minnesota, and Wisconsin require that no more than 1.0 mg/L be discharged from municipal plants. Phosphorus control programs in the Ontario portion of the Upper Lakes Basin are under review in light of the requirements of the 1978 Agreement.

There was essentially no change in the municipal phosphorus loads to lakes Superior and Huron in 1978 compared to 1977 (Table 3.5). A significant reduction was observed in the municipal phosphorus load to Lake Michigan attributed to implementation of phosphorus control requirements in Michigan and Wisconsin.

LOWER LAKES

Programs to limit the discharge of phosphorus to 1.0 mg/L in all municipal treatment plants with a capacity greater than 3800 m^3/d (1 MGD) are in effect in both Canada and the United States for the Lake Erie and Lake Ontario basins. Municipal phosphorus loadings have decreased in the Lake Erie and the Lake Ontario basins; Canada was below the target for Lake Erie and slightly exceeded the target for Lake Ontario. The United States loads have decreased substantially but are still more than double the target loads for both Lake Erie and Lake Ontario. The target of 1.0 mg/L is far from being attained on either lake. Detroit continues to be the greatest offender, contributing 48 percent of the municipal phosphorus load to Lake Erie in 1978 (Tables 3.5 - 3.7). It should be noted that when all plants in the basin achieve the 1.0 mg/L target, Detroit will still contribute about 36 percent of the residual load.

The ranking of municipal plants discharging to the Great Lakes, based on the amount of phosphorus they discharge in excess of the 1.0 mg/L target is also indicated on Tables 3.6 and 3.7. Detroit dominates the list, but Buffalo, Euclid, Cleveland Southerly, and Toledo all discharge more than 500 kg/d in excess of what they would be discharging at the 1.0 mg/L target.

Programs for all treatment plants in the Lower Lakes Basin to achieve 1.0 mg/L are expected to be fully operational by 1983. The phosphorus effluent target of 1.0 mg/L or less was achieved in 1978 at 40 of 68 Canadian plants and 32 of 112 United States plants reported as discharging more than 3800 m^3/d (1 MGD) in the lakes Erie and Ontario basins.

There has been progress in the basin in reducing phosphorus inputs to the lakes from municipal sewage. For the entire Great Lakes, the aggregate concentration (total load divided by total flow) has been reduced from 2.6 mg/L in 1975 to 1.8 mg/L in 1978. The aggregate phosphorus concentrations for 1975-1978 for each lake is shown in Table 3.8.

The Board has instructed its subcommittees to carry out an indepth assessment of phosphorus control programs for municipal wastewater treatment plants in the Great Lakes Basin, including an assessment of the quality of effluent data received from these plants. The study will be the subject of a special report to the Commission.

TABLE 3.5
REPORTED MUNICIPAL PHOSPHORUS LOADS IN THE GREAT LAKES BASIN[1]

LAKE BASIN	POPULATION SERVED	PHOSPHORUS LOADINGS IN KILOGRAMS PER DAY					
		1975	1976	1977	1978	"Target"[2]	"Excess"[3]
SUPERIOR							
United States	259,100	447	511	315	359	154	205
Canada	121,900	155	178	279	250	72	178
HURON							
United States	732,000	427	326	477	548	449	99
Canada	446,000	470	479	489	551	246	305
MICHIGAN							
United States	3,901,000	5,768	6,548	4,703	3,510	3,123	387
ERIE							
United States	6,400,000	21,180	17,880	17,827	15,380	6,257	9,123
Canada	300,000	600	690	686	607	660	-
ONTARIO[4]							
United States	1,700,000	5,000	4,210	6,149	4,297	2,132	2,165
Canada	3,800,000	6,780	3,620	3,130	2,935	2,467	468

[1]Phosphorus loadings for 1975, 1976, 1977, and 1978 as reported for sewage treatment plants over 3,800 m^3/d (1 MGD).

[2]"Target" - Loading with all municipalities at 1.0 mg/L "P" based on 1978 flow.

[3]"Excess" - Loading for 1978 minus calculated loading if effluent concentration were 1 mg/L.

[4]Including St. Lawrence River.

NOTE:

Loadings reflect the number of plants reporting each year. Specific year-to-year comparisons are not advisable.

TABLE 3.6

MUNICIPAL PLANTS IN LAKE ERIE BASIN OVER 38,000 M^3/D (10 MGD) 1978 FLOW

	PHOSPHORUS LOADINGS						AVERAGE ANNUAL EFFLUENT PHOSPHORUS CONCENTRATION (mg/L)			
	REPORTED (kg/d)				TARGET (kg/d)					
	1975	1976	1977	1978	1977	1978	1975	1976	1977	1978
UNITED STATES										
Michigan										
1 Detroit	12,940	11,290	10,336	7,179	3,040	2,469	3.6	3.2	3.4	2.9
Wyandotte	1,543	993	435	299	272	299	5.7	3.7	1.6	1.0
Warren	140	140	-	91	-	114	1.2	1.2	-	0.8
Pontiac	45	46	22	15	99	87	0.6	0.6	0.2	0.2
Ann Arbor	142	174	-	122	-	129	2.3	2.2	-	0.9
Port Huron	71	62	65	58	34	41	1.1	1.1	1.9	1.4
Monroe, Michigan	60	27	30	10	50	42	1.1	0.5	0.6	0.3
Ohio										
Cleveland										
Easterly	723	513	483	289	501	485	1.8	1.2	0.9	0.6
4 Southerly	417	290	898	1,203	360	377	1.2	0.8	2.3	3.2
8 Westerly	375	340	383	401	123	111	3.0	2.6	3.2	3.6
5 Toledo	800	558	955	747	377	317	2.5	1.4	2.5	2.4
Akron	493	439	712	380	298	315	1.4	1.4	2.3	1.2
2 Euclid	462	299	407	1573	72	113	6.7	2.0	5.6	13.9
Lima	369	31	27	33	58	51	5.5	0.5	0.5	0.7
7 Lorain	93	309	271	370	53	60	1.6	5.1	5.1	6.2
Lakewood	-	143	100	33	43	47	-	2.8	2.3	0.7
Sandusky	-	36	32	36	39	43	-	0.8	0.8	0.8
Pennsylvania										
Erie	383	383	438	433	435	195	2.2	2.2	1.8	2.2
Indiana										
Fort Wayne	105	92	94	77	164	134	0.8	0.8	0.6	0.6
CANADA										
Ontario										
Windsor Westerly	85	94	59	77	100	96	0.8	0.9	0.3	0.8
London Greenway	52	87	107	54	107	107	0.6	0.9	1.0	0.5
Kitchener	63	105	84	72	65	60	0.9	1.4	1.3	1.2
Guelph	39	40	37	39	45	44	1.0	0.8	0.8	0.9
Brantford	63	72	75	56	44	46	1.4	1.5	1.7	1.2
Sarnia	19	49	34	32	38	37	0.6	1.1	0.9	0.9

() Rank by phosphorus load discharged in excess of load at 1 mg/L.

Note: Grand Rapids, Michigan in the Lake Michigan Basin is ranked 9th.

TABLE 3.7

MUNICIPAL PLANTS IN LAKE ONTARIO BASIN OVER 38,000 m^3/D (10 MGD) 1978 FLOW

	PHOSPHORUS LOADINGS						AVERAGE ANNUAL EFFLUENT PHOSPHORUS CONCENTRATION (mg/L)			
	REPORTED (kg/d)				TARGET (kg/d)					
	1975	1976	1977	1978	1977	1978	1975	1976	1977	1978
UNITED STATES										
New York										
[3] Buffalo	1,648	1,518	1,796	1,771	665	705	2.5	2.3	2.7	2.5
[6] Syracuse	610	565	813	613	239	221	2.3	1.9	3.4	2.8
Rochester										
Frank Van Lare	522	398	317	336	244	313	2.0	1.4	1.3	1.1
Gates-Chili-Ogden	132	147	159	140	45	48	3.3	3.4	3.5	2.9
Northwest Quadrant	109	61	41	45	34	44	3.8	1.6	1.2	1.0
Niagara Falls	256	-	815	244	247	125	1.0	-	3.3	2.0
Tonawanda S.D.#2	259	265	312	243	57	59	5.4	5.3	5.5	4.1
Auburn	36	106	82	87*	36	38	1.0	2.5	2.3	2.3
Lockport	18	4	4	8	51	55	0.5	0.1	0.1	0.1
CANADA										
Ontario										
Toronto										
Main	2,650	880	599	567	698	763	3.4	1.1	0.9	0.7
Humber	410	320	318	377	344	377	1.2	0.9	0.9	1.0
Highland Creek	480	130	200	152	133	127	4.5	1.1	1.5	1.2
North Toronto	23	30	25	24	39	40	0.6	0.8	0.6	0.6
[10] Hamilton	507	410	329	498	254	237	2.1	1.6	1.3	2.1
Lakeview-Mississauga	620	609	327	177	173	171	4.2	3.4	1.9	1.0
Kingston	140	47	52	60	58	60	2.5	0.8	0.9	1.0
Burlington Skyway	86	60	48	108	59	60	2.0	1.1	0.8	1.8
Cornwall	110	140	248	218	56	53	2.4	2.7	4.4	4.1
Peterborough	50	60	45	48	45	44	1.2	1.3	1.0	1.1
Oshawa	170	79	73	156	49	52	3.7	1.8	1.5	3.0
Belleville	67	58	29	35	36	35	2.1	1.4	0.8	1.0
Niagara Falls	130	65	60	41	46	41	3.5	1.7	1.3	1.0

() - Rank by phosphorus load discharged in excess of load at 1 mg/L.
* - Estimated from 1977 data.

Note: Grand Rapids, Michigan in the Lake Michigan Basin is ranked 9th.

TABLE 3.8
AGGREGATE[1] PHOSPHORUS CONCENTRATIONS
FOR MUNICIPAL WASTEWATER EFFLUENTS

LAKE BASIN	PHOSPHORUS CONCENTRATION (mg/L P)			
	1975	1976	1977	1978
Superior	4.0	4.5	3.8	2.9
Michigan	1.9	2.0	1.6	1.2
Huron	2.1	1.6	1.5	1.7
Erie	2.9	2.4	2.5	2.3
Ontario	2.7	1.8	2.0	1.6
St. Lawrence River	2.4	1.6	2.4	2.6
Great Lakes Basin	2.6	2.1[2]	2.2	1.8

[1]The total phosphorus load divided by the total flow reported for plants discharging more than 3800 m^3/d in each basin.

[2]The 1976 value is low because of omission of data from New York State.

INVENTORY OF MAJOR DISCHARGERS IN THE GREAT LAKES BASIN

Information in this chapter was summarized from an "Inventory of Major Municipal and Industrial Point Source Discharges in the Great Lakes Basin", which is maintained at the IJC Great Lakes Regional Office. Those industrial or municipal dischargers which, in the judgement of the pollution control agencies, contribute a large volume of effluent or may be capable of discharging a significant pollutant, are classified as major dischargers. The inventory, which is updated annually, describes the status of control programs, effluent requirements and pollutant loadings for these major dischargers and gives the Water Quality Board an effective method of monitoring the progress made in controlling point source discharges.

Copies of the point source inventory in the form of computer printout are available from the IJC Great Lakes Regional Office or the offices of the federal, state or provincial pollution control agencies in the Great Lakes Basin. The inventory contains basic information for over 860 major dischargers, summary tables listing historical phosphorus loadings for municipal dischargers, lists ranking the municipal treatment plants not meeting 1.0 mg/L P, and total point source phosphorus loads - municipal and industrial, direct and indirect - to each lake.

The submission of information on the status of compliance with regulations and amounts of pollutants discharged by over 860 individual dischargers in the entire basin places a heavy burden on the agencies contributing information for the Water Quality Board report. It is evident that the increasing reporting requirements will require additional commitment of resources by

jurisdictions involved in the Great Lakes Water Quality Agreement if a complete and accurate inventory of point source dischargers is to be maintained and serve a useful function.

SOCIO-ECONOMIC CONSIDERATIONS IN CONTROL REQUIREMENTS

The Commission asked the Water Quality Board at the July 1978 Annual Meeting what role inflation plays in the enforcement of water quality control regulations. The Board cannot analyze the impact of the economic climate on enforcement decisions for individual violations of regulations. However, members recognize that economics may play a role in the development and enforcement of these regulations.

The following economic approaches provide a general outline of how economic factors are considered in United States and Canada.

UNITED STATES

The United States Clean Water Act establishes a framework in which several opportunities for formal expression of economic conditions exist in the development of regulations, their application and their enforcement. The intent is to involve economic considerations in the process so that abatement is not seriously slowed down or industrial viability undermined.

For industrial discharges, economic conditions are considered in the development of nationwide effluent guidelines for "best available technology economically achievable" and other effluent guidelines categories. An economic assessment is done for each guideline to assure that the proposed technology is achievable on an industry-wide basis. Industry and the public have ample opportunity to contribute to the guideline development process and often do so through formal comment or by litigation.

In the development of water quality standards, municipalities and industries have an opportunity to express local difficulties with standards on economic grounds through the states' formal hearing processes. Though the process is closely governed by state and national policy and criteria, variances have been given in extraordinary circumstances to allow a rate of progress in clean up which matches the capacity of the dischargers involved.

To offset the advantages gained by a company which does not meet a pollution control limit on time, the United States has a "penalty policy" to request the court to set fines which are at least as large as the firm's economic savings from delaying installation and operation of treatment equipment. The intention is to create equity for the firms which have met effluent limits in accordance with the law.

In cases of severe economic hardship for a company or an area faced with plant closings, opportunities for waiver of limits do exist in very restricted circumstances involving "best available technology" so long as pollution abatement continues to progress. When plant closures are threatened, the EPA's response is to use the "Economic Dislocation Early Warning System", which arranges for assistance to plants and employees by other federal agencies.

In cases where effluent limit violations are brought to court, the company may argue economic disability to mitigate any penalties a court might assess to redress the violations.

In spite of the major funding role of the federal government, economic conditions may hamper the ability of municipalities to obtain adequate taxes to operate facilities. In these cases, the agencies, through court action, can seek to alter the relative priority given by municipalities to sewage treatment. This has been done in the case of Detroit. The basic economic problems of Detroit, Gary, and several other cities, however, continue to make sewage treatment problems in these areas difficult to resolve.

CANADA

In Canada, the development and implementation of pollution control legislation, regulations, and programs have not been adversely affected by fluctuations in the economic climate. Consideration is given to the socio-economic impact of pollution control and environmental protection in a number of ways. These are summarized below:

Socio-economic Impact Analysis (SEIA) - In December 1977, the Government of Canada required all new federal regulations in the area of health, safety and fairness that could have a significant effect on the Canadian economy be subjected to socio-economic impact analysis as part of the process of regulation development.

Regulation Development Task Forces - In addition to the above, Environment Canada, in the process of regulation development for the Fisheries Act, Clean Air Act, and Environmental Contaminants Act, formed a task force composed of representatives from the federal and provincial agencies and the industries affected. Water pollution control regulations are based on effluent limitations to achieve adequate environmental and human health protection through the application of practicable abatement technology.

Proposed regulations are published in the Canada Gazette, and the Minister responsible may receive public comment and considers these comments before final promulgation.

The Province of Ontario developed and implemented pollution control programs which generally have not been affected by recurrent business cycles. Undoubtedly, individual companies are subject to variations in business patterns, including the effects of foreign competition and rates of exchange where export trade is involved. To encourage compliance with its requirements, the province employs a variety of incentives which it believes can be achieved without significant contraction of industry in terms of mill closures or large employee layoffs. The latest example of this approach is the recent establishment of a Committee of Ministers to consider proposals and allocate government funds to encourage plant modernization and environmental projects to achieve provincial objectives for environmental quality.

Further, the government makes a socio-economic appraisal of new policy proposals embracing impacts on both the private and public sectors. Private sector considerations include job creation-job loss, effect on investment capital, encouragement to form new business, organizational duplication,

effect on consumer prices, reduction of the incentive to work, and the cost of compliance. In the public sector, effects on government work force and government expenditures are also appraised.

LEGISLATIVE AND REGULATORY HIGHLIGHTS DURING 1978

Changes and improvements during 1978 to the legislative and regulatory base that each country has utilized in implementing the Agreement are described in this section. This is part of a continuing effort to develop and implement programs and measures to restore and enhance the water quality of the Great Lakes. Further discussion on toxic and hazardous waste programs is provided in Chapter 4, and airborne pollutant control programs are discussed in Chapter 7.

UNITED STATES

FEDERAL LEGISLATION

Toxic Substances Control Act (TSCA)

Under the Act, PCBs were banned from all use, except use in a totally enclosed manner, on January 1, 1978. Proposed regulations for completing the PCB ban were published on June 7, 1978. The proposed rules apply to any "PCB mixture" containing 50 parts per million or more of PCB.

An eight-member Interagency Testing Committee, formed to recommend the chemical substances for which EPA would require testing by chemical manufacturers and processors, submitted its initial recommendations on October 3, 1977 and updated the list on April 19, 1978. Eighteen classes of chemical substances are included.

On March 16, 1978, EPA published a policy statement on the interpretation and enforcement of the "notification of substantial risk" provisions. In essence, the section provides that organizations must inform EPA of any data indicating potential risk or injury to health or environment from any substance they manufacture, process or distribute.

EPA developed security procedures for the handling of confidential business information obtained under TSCA. EPA published the procedures in the "TSCA Confidential Business Information Security Manual" in July 1978.

Resource Conservation and Recovery Act (PL 94-580)

The objectives of the Act are: (1) to regulate hazardous wastes from the point of generation through disposal, improvement of disposal practices for all other wastes to meet environmental and health standards, and (2) to promote resource recovery and conservation as the preferred waste management approach.

At present, seven sets of hazardous waste regulations are in various stages of preparation under the Act. Five of the regulations have been formally proposed in the Federal Register: Identification and Listing Hazardous Waste; Standards Applicable to Generators of Hazardous Waste; Standards Applicable to Transport of Hazardous Waste; Standards Applicable to

Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; and Authorized State Hazardous Waste Programs. The final regulations for these sections are due in December 1979.

The criteria for land disposal of non-hazardous wastes were proposed in February 1978. The proposed criteria cover protection of water and air quality, environmentally sensitive areas such as wetlands, requirements to be met in applying sludge or other waste to foodchain crop lands, control of disease vectors, and safety measures. The criteria should be issued in final form in July 1979.

Toxic Substance Effluent Control

The EPA Effluent Guidelines Program is developing discharge limitations for 129 toxicants which will be incorporated into the reissuance process for permits. Selected industries will be required to conduct indepth process evaluations as a part of their permit reapplication. The manufacturing categories affected are organic and inorganic chemicals, pesticides, herbicides, and pulp and paper industries.

United States EPA Pretreatment Regulations

General Pretreatment Regulations for Existing and New Sources of Pollution were published June 26, 1978. EPA will now begin issuing final industrial pretreatment guidelines to be implemented by either municipalities, states or EPA. States and publicly owned municipal treatment works (POTWs) are required to develop programs (in addition to the national guidelines for 129 toxicants) to control toxic substances which may cause local or regional problems. It is the aim of these regulations to encourage the reuse of municipal wastewater and use of sludge for productive purposes rather than the prevalent practices of discharging, landfilling or incinerating.

The pretreatment regulations require that all POTWs with total flow over 5 MGD and which serve industries for which pretreatment standards are being developed must apply and operate an NPDES pretreatment program. For POTWs under 5 MGD, the state or EPA may operate the pretreatment program directly or delegate the program to the POTW. It is expected that most states will delegate pretreatment requirements to POTWs in the range of 1 MGD or greater that have a significant number of industries.

A city may apply directly to operate a pretreatment program or wait until it is added to its NPDES permit or municipal grant. Grant funds of 75 percent are available to assist a city in financing equipment and facilities to initiate a pretreatment program. This program should be fully instituted as soon as possible but by no later than July 1, 1983. As an added incentive, advance grant funding requests must be submitted before December 31, 1980.

If a state or municipality has not taken over operation of the program when industrial discharge guidelines become effective, EPA will assume monitoring and enforcement authority. When program operation has been delegated, EPA will maintain an overview role as is presently done in the NPDES permit program. If an industry does not significantly comply with pretreatment standards, a POTW or EPA may initiate an enforcement action.

Programs to Control Spills of Toxic or Hazardous Substances

On February 16, 1979, the United States EPA defined the units of measurement and rates of penalty for spill events for 299 substances. The Agency also proposed the minimum quantity for a reportable spill. Illegal discharges to sanitary sewers by waste haulers in excess of reportable quantities are also covered by the regulations.

Municipal Treatment Technology

The United States EPA revised construction grant funding regulations relating to alternative and innovative technologies for municipal waste treatment in September 1978. Alternative processes, including disposal on land, are defined as proven methods of reclamation or reuse of water, productive recycling of wastewater constituents, elimination of pollutant discharge or energy recovery. Innovative technologies are those which have not been fully proven.

To encourage such technologies, a 10 percent increase in the federal grant to 85 percent is authorized, and a 15 percent preference in cost-benefit analysis is allowed in the grant award process. All proposals for municipal waste treatment plants are required to consider alternative and innovative technologies in the feasibility planning phase of the project.

Rural Clean Water Program

The United States Department of Agriculture Soil Conservation Service published rules and regulations for the Rural Clean Water Program in the Federal Register, November 1, 1978. This document outlines the structure and procedures for applying for federal cost sharing funds to implement best management practices to control agricultural nonpoint source pollution for improved water quality.

Each state is encouraged to submit project applications for Rural Clean Water Program funding by August 1, 1979 for Fiscal Year 1980 funding consideration. Those project applications that have been approved by the Governor and the State Rural Clean Water Program Coordination Committee in accordance with an approved Section 208 plan will be eligible for National RCWPCC award selection. However, there are no funds available at this time for project awards.

STATE LEGISLATION

Michigan Solid Wastes Law

Michigan's new solid waste law revamps the Department of Natural Resource's authority over solid waste disposal. It is expected to significantly smooth the implementation of Subtitle D of the Federal Resource Conservation and Recovery Act in Michigan.

Ohio Solid Wastes Law

The State of Ohio amended the solid waste laws to be effective March 1979 to enable the state to carry out programs pursuant to the Federal Resource

Conservation and Recovery Act, as well as the Hazardous Materials Transportation Act.

Wisconsin Detergent Phosphorus Legislation

Legislation which limits cleaning agents for machine dishwashers and medical equipment to 8.7 percent P, water conditioners to 20 percent P, and all other cleaning agents to 0.5 percent P was enacted and became effective July 1, 1979. The law exempts certain cleaning agents such as those for industrial processes and dairy equipment. In addition, the law requires the Department to conduct a study to determine the effect of restricting phosphate laundry detergents on sample lakes.

Wisconsin Water Conservation Legislation

Chapter 275, Laws of 1977, was enacted in May 1978. The intent of this law is to conserve water by prohibiting the sale and installation of plumbing fixtures which do not meet certain limits on water consumption.

Wisconsin Fund Program Summary

Wisconsin needs to spend over $2.7 billion to meet 1983 goals of the Clean Water Act. The legislature passed the Wisconsin Fund in May 1978 to provide money to communities for improved water pollution abatement and solid waste management. Those funds to control point source pollution will be administered by the Wisconsin Department of Natural Resources with $60 million allocated for 1979.

The Wisconsin Fund also assists in the application of the best methods of controlling nonpoint source pollution. In 1978-79, $1.2 million will be available for cost-sharing, with approximately 70 percent of those funds being allocated to "priority watersheds" where small expenditures will be most effective in improving or protecting water quality.

A third part of the Wisconsin Fund is a $500,000 grant program to assist local governments to finance solid waste and sanitary landfill planning.

STATE WATER QUALITY STANDARDS

Water quality standards are an important mechanism used by the states in their programs to control pollution of waters in their jurisdiction, including the Great Lakes. These standards must be revised periodically by the states through a public hearing process and require approval by United States EPA.

Current revisions are being based on criteria issued by United States EPA, Great Lakes Water Quality Agreement objectives, and local considerations.

The present revision process began in 1976 and is at the following stage in the various states:

Illinois - Limited revisions are being adopted.

Indiana - Revisions pertinent to the Great Lakes were adopted June 25, 1978.

Michigan - On April 19, 1979, the Water Resources Commission discontinued procedures to establish the proposed water quality standards and to develop new revised standards. Revised standards will be formulated by a committee composed of representatives from the state, industries, municipalities, and other interested parties. It is anticipated that this process will be completed within one year.

Minnesota - Standards are still under revision.

Ohio - Ohio and United States EPA approved the proposed water quality standards with the following exceptions:

a) criteria for cyanide, dissolved oxygen, and temperature
b) certain criteria for mixing zones
c) the designation of seasonal and limited warmwater habitat pending submission of further qualification.

Wisconsin - Revisions approved by United States EPA September 8, 1978.

Pennsylvania - Revised standards will be presented to the Environmental Quality Board in July 1979 for final adoption.

New York - Proposed revisions to the Water Quality Standards were the subject of public hearings in late 1978. As a result of significant adverse public comment, these standards revisions were withdrawn for reconsideration. Revised standards will be developed, and an Environmental Impact Statement prepared to address the socio-economic impacts of the proposed standards before they are again resubmitted for public review.

CANADA

FEDERAL LEGISLATION

Environmental Contaminants Act

Under the Environmental Contaminants Act, the following regulations were passed in 1978/79 for the following substances:

Polybrominated Biphenyls - a total ban (March 1, 1979)
Polychlorinated Terphenyls - a total ban (May 1, 1979)
Mirex - a total ban (December 1, 1978)

Also two regulations are in the proposal stage. They are for:

Chlorinated Fluorocarbons - to be banned in non-essential uses (spray deodorants, hair sprays, anti-perspirants)

Polychlorinated Biphenyls - amendment to existing regulation to restrict use in servicing transformers.

PROVINCIAL LEGISLATION

Water Management

In November 1978, the Ontario Ministry of Environment published its revised "Goals, Policies, Objectives and Implementation Procedures for Water Management in Ontario". The province has agreed that the revised specific water quality objectives contained in the 1978 Great Lakes Water Quality Agreement shall be used to achieve and maintain water quality in the Great Lakes. The revision takes into account the requirements of Article VI, Section 1(b) of the 1978 Agreement, specifying the establishment of effluent limitations for industrial facilities. Such requirements will be incorporated in Certificates of Approval for new or expanded work, and in formal programs and control orders for existing waste dischargers.

Where toxic substances are identified, the Ministry encourages municipalities to adopt its model sewer use bylaw for industrial waste control. The Ministry monitors for a range of toxic substances in air, soil and water, including ground water. Effluent and sludge disposal practices are monitored regularly.

Cleanup of Spills

In December 1978, a bill was introduced in the Ontario Legislature to amend the Environmental Protection Act of 1971 with respect to spills of pollutants including toxic substances to the natural environment. The proposed bill was revised as a result of comments and suggestions received by the Ministry of Environment and reintroduced in March 1979. The objectives of the bill are: 1) to impose a clear responsibility for control, cleanup and restoration on owners and those in charge of pollutants; 2) to broaden the authority of the Minister to order control and cleanup of spills and restoration of the natural environment by those responsible, and when necessary, by other persons; 3) to enable the Ministry to take immediate remedial action in the event of a spill and to pursue the question of liability later; 4) to establish liability for compensation for damage resulting from a spill and for the cost of cleanup; 5) to enable a person who has been ordered by the Minister to clean up a spill, other than a person already responsible to do so, to recover his reasonable expense from the Ministry; 6) to authorize control and cleanup of spills and restoration of the natural environment by municipalities and designated persons and to provide them with the right to recover their reasonable expenses from the owner and the person in control.

Hazardous Substances Control

A number of hazardous substances which may be emitted or discharged to air and water in Ontario are controlled through limitations contained in orders with similar requirements applicable to waste disposal operations.

Sixteen classes of organic and inorganic chemical substances are being assessed for hazard by an interagency technical committee. The results are expected to lead to appropriate restrictions on use.

The hazardous waste disposal program, introduced late in 1978, centres around measures to ensure that solid and liquid wastes are managed to protect

the environment. Highlights include concerted efforts to locate and develop suitable sites for waste treatment and disposal, a revised way bill system, and an inventory and assessment of abandoned disposal sites.

Two sets of guidelines published in 1978 include specifications for classification, treatment and disposal of liquid industrial wastes and guides for management of PCBs.

Other measures under development include:

- provision for limited term storage of PCB wastes;
- regulations for storage, movement and disposition of used electrical equipment containing PCBs;
- regulations to prohibit direct landfilling of liquid wastes;
- regulations controlling the ultimate repository of specific hazardous wastes;
- registration by generator of wastes produced;
- measures for perpetual care of sites where long term surveillance and maintenance is required.

The province does not restrict interjurisdictional movement of hazardous wastes, provided these are directed to approved disposal locations.

Reduction of Erosion

Through a farm production incentive program, the Ontario Ministry of Agriculture and Food has introduced grants to stimulate efforts to reduce soil erosion and to discourage cattle from watering along streambanks. The grant amounts to 40 percent of the capital expenditures for a variety of projects up to a maximum of $1500.

Erosion control demonstration projects developed through County Soil and Crop Improvement Associations may also receive support. Eligible projects include such measures as grassed waterways, ditch bank stabilization, large contour systems and similar erosion control efforts. Agricultural engineering extension services are directing renewed attention to providing guidance in the design and support for individual erosion control projects.

4 TOXIC AND HAZARDOUS SUBSTANCES

The Water Quality Board, in reviewing the contaminants problem in the Great Lakes Basin, has found that the national programs of both countries and the individual programs of the jurisdictions are addressing the problem in varying degrees and from a number of viewpoints. There already exists a large number of programs directed toward the control of toxic substances in various parts of the ecosystem. These individual programs to control contaminants released to air, water, and land; in food; from industrial and agricultural practices; and other sources result in a diversified and segmented approach to the whole problem. The new emphasis on toxic substances is reflected in the preceeding chapters.

The Board recognizes the importance and enormity of the task confronting agencies involved in implementing laws to control toxic and hazardous substances. Accordingly, the Board has placed greater emphasis on toxic substances by directing its committees to focus on these substances in the Great Lakes Basin. In keeping with this new focus, the Board is sponsoring a series of workshops as part of a comprehensive review of the contaminants problem and programs to control the discharge of toxic and hazardous substances in the Basin. A steering committee was appointed to organize and conduct the workshops under the supervision of the Water Quality Board.

HAZARD ASSESSMENT

The first of the series of workshops was held April 9-11, 1979 to review the procedures used by agencies in hazard assessment because of its importance in regulatory decision-making for toxic substances control.

The workshop demonstrated that the fragmented approach to hazard assessment by the different agencies makes appraisal of the effectiveness of programs directed at the Great Lakes problems difficult. The report of the steering committee for the workshop is found in Attachment 1.

The Board concludes there is a need for a hazard assessment program to integrate the efforts of all agencies and evaluate the hazard of toxic substances found in the Great Lakes Basin. Such a program would not be a substitute for other assessment operations. There is a need to maintain and expand existing programs and ensure they are compatible with the requirements in the 1978 Agreement. Accordingly, the Board recommends that a small work group be formed to conduct a hazard assessment program specifically oriented to the Great Lakes ecosystem to complement existing agency efforts. The success of this effort requires the commitment of agencies to participate in the program and to consider the assessment in their individual programs.

Other workshops will be deferred until the hazard assessment component of the program is more fully developed. The Board also recognizes that of the many other elements of toxic substances control, the problems of hazardous waste disposal is one of the most pressing.

HAZARDOUS WASTE DISPOSAL

Last year, the Board brought to the attention of the Commission the urgent need for adequate disposal facilities for hazardous waste. Since that time, the lack of any new disposal sites in the basin and increased public awareness of the detrimental human health and environmental effects of abandoned disposal sites have heightened the critical nature of this problem.

SITING PROBLEM

Citizen resistance to the establishment of disposal sites is still a major deterrent in implementing a hazardous waste disposal program. No new sites have been established in the basin in the past 12 months.

New York State issued a permit for the expansion of an existing site but law suits are now underway against the state by local citizens. In Ontario, both public resistance and technical uncertainties contributed to the province's decision to deny approval of a proposal for disposal facilities at a site in the Lake Erie Basin.

The fears and resistance of citizens have been further emphasized by the Love Canal situation. As siting of approved facilities becomes more difficult, the need for these sites becomes more acute.

Without disposal sites for hazardous wastes, the Board considers that the quality of the Great Lakes ecosystem cannot be adequately protected. Recognizing the urgent necessity for adequate disposal sites and the mounting public resistance, the Commission is advised to consider conducting public hearings throughout the basin to increase public understanding of the importance and necessity of providing adequate facilities.

DISPOSAL PRACTICES

Disposal practices for hazardous waste are also a concern of the Water Quality Board. Temporary storage, a common practice when disposal sites are not available, may be a serious threat to the health and safety of a community. The use of poorly constructed solid waste sites for the disposal of hazardous wastes is a dangerous practice. Additional time and effort are needed to determine the full extent of the hazardous waste problem.

Drainage from active and abandoned sites has severely damaged surface and ground waters in some areas of the basin. Wherever a problem is identified, action must be taken to collect and treat seepage water to prevent further contamination. Though difficult and expensive, in-place treatment is the only currently feasible alternative because of the difficulty of establishing new disposal sites.

The Board concluded that the most serious environmental and health risk in the basin is the existence of uncontrolled concentrations of hazardous wastes, whether they exist as improperly constructed disposal sites or inadequate temporary storage facilities. The Board reaffirms with a greater sense of urgency the recommendations to the Commission made a year ago and contained in Attachment 2 of this report.

HAZARDOUS WASTE CONTROL PROGRAMS

Regulations and control programs are still in the planning and development stages in most jurisdictions, and there is at this time no effective basinwide operating plan to cope with the generation, transportation, and disposal of hazardous waste in the Great Lakes Basin. Efforts to apply newer technologies in appropriate ways are in the early stages of development. Wastes, however, continue to be generated and disposed of by uncontrolled and sometimes disastrous methods. Love Canal in Niagara Falls, New York is typical of possibly hundreds of similar disposal areas throughout the basin.

The Board acknowledges the Commission's concern about the Love Canal waste disposal site and the probability of the existence of similar situations in the basin. The Board is, however, aware of actions in both countries to identify abandoned or existing hazardous waste sites. Status reports on these actions will be submitted by Canadian and United States Governments directly to the Commission in response to a request by the Commission.

The Water Quality Board, through its Remedial Programs Subcommittee, has begun an analysis of the programs underway in all jurisdictions to cope with all aspects of the toxic substance problem. The Board will include this information with the results of the series of workshops on Toxic and Hazardous Substances in a report to the Commission.

Regulatory and legislative activities by both countries during 1978 to control toxic and hazardous wastes are described in Chapter 3.

ANALYTICAL PROCEDURES

The programs to control the discharge of toxic materials to the Great Lakes have developed in response to specific problems, such as contamination of fish by mercury and certain pesticides, identified in the environment. The 1978 Agreement specifies that the discharge of toxic substances in toxic amounts be prohibited and discharge of all persistent toxic substances be virtually eliminated. One of the essential elements in a program to control these substances is the ability to identify and measure them in the environment. Because of the very small concentrations of these materials in the Great Lakes and their complex chemical structure, it is necessary to make use of advanced analytical techniques. Highly specialized and very expensive equipment is needed along with the highly trained expertise to analyze and interpret the results. To ensure effective utilization of equipment, emphasis should be given to approaches which take advantage of higher concentrations such as analysis of fish contaminant and specific industrial processes.

The availability of equipment and qualified personnel is severely limited in the Great Lakes Basin and will seriously handicap the toxic substance control programs unless immediate steps are taken by the jurisdictions to provide both the laboratory equipment and the personnel to operate it.

5 RADIOLOGICAL ASSESSMENT

LAKE ASSESSMENT

In accordance with the changes introduced by the International Commission on Radiological Protection (ICRP), discussed below, the "doses" presented here are implied values incorporating the weighting (risk) factors in ICRP Publication 26.

The overall radiological quality of the Great Lakes remains essentially unchanged from 1977. Differences in the reported levels of radioactivity for the open lakes are not large and are not consistent enough to support attempts at long term projection. ^{90}Sr (strontium-90) is still the most important contributor to the annual dose to man, and the major source is fallout from the atmospheric testing of nuclear weapons. The ingestion of ^{90}Sr in water from the Great Lakes would yield doses of 0.02, 0.10, 0.05, 0.05, and 0.06 mrem for water from Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario, respectively; these doses are similar to those reported for previous years and are well below the objective (1.0 mrem per year).

The average concentration of ^{3}H (tritium) in each of the Great Lakes ranges from less than 260 to 400 pCi/L, which is equivalent to an annual dose of 0.03 millirem (mrem) or less. The maximum annual dose due to ingestion of lake water (except from the Serpent Harbour, Ontario area and in the vicinity of Port Hope, Ontario) would come from drinking water from Lake Michigan; this dose (0.13 mrem) is considerably less than the objective of 1.0 mrem per year.

The average 1978 concentration of ^{226}Ra (radium-226) at the mouth of the Serpent River was 2.4 pCi/L, which is less than the Ontario criterion of 3.0 pCi/L for public surface water supplies. This average concentration is equivalent to an annual dose of 1.0 mrem. The data indicate that the major sources of radioactivity to the Serpent River are probably natural inputs from the bedrock as well as leaching from tailings piles at abandoned mines upstream in the drainage basin.

Ingestion of raw water from Lake Ontario in the Port Hope, Ontario area would result in an additional dose of 0.09 mrem because of the presence of ^{226}Ra in the water.

Although elevated levels of ^{3}H were reported well upstream in Cattaraugus Creek, New York, which drains the area surrounding the Nuclear Fuel Services reprocessing facility and waste storage site, the levels in the vicinity of the creek mouth in Lake Erie are below the detection limit.

SURVEILLANCE

Present radioactivity surveillance activities on the Great Lakes and the data they generate are generally adequate to determine compliance with the radioactivity objective and to determine trends in the radiological quality of

the water. The programs are, however, not adequate to determine total intake of radionuclides by man from drinking water and eating fish from the lake, nor are the present programs adequate to determine the dispersion and fate of radionuclides in the biota and the sediment. Radioactivity surveillance is a part of GLISP to be published in 1979, and is expected to increase as the surveillance plan is implemented and as drinking water monitoring requirements are strengthened.

NUCLEAR FUEL CYCLE

In response to a request from the International Joint Commission concerning the possible impact of the Canadian and the U.S. nuclear fuel cycles on the Great Lakes Basin, the Radioactivity Subcommittee prepared a report on fuel cycle activities, with emphasis on waste management; the impact from typical facilities for both normal and abnormal operation; and the impact of existing facilities on the Great Lakes Basin. Details are given in Appendix D.

The components of the nuclear fuel cycle include mining and milling of the uranium ore; conversion, enrichment, and fabrication of the uranium into a form suitable for use as fuel in a power reactor; generation of electric power; and storage and disposal of the spent fuel and reprocessing waste.

An accurate evaluation of the impact of the nuclear fuel cycle is not possible at this time. The multitude of risk studies performed in this area, e.g. reactor accidents or breach of repository integrity, are not supported by an adequate data base. Estimates of radiological impact are most commonly made by assessing the risk, which is the product of the probability of an event and its consequence. In most critical areas, neither of these is known with any degree of certainty. The radiation dose and consequent health effects resulting from "normal" operations in the fuel cycle would, however, be small.

The components of the nuclear fuel cycle of greatest concern are mining and milling, storage and disposal of spent fuel, and decommissioning of power plants.

Mining and milling are of concern, primarily because of the potential for the long term release of radioactivity from abandoned mill tailings piles. Current plans call for a major expansion in mining and milling activities in the Elliot Lake area. This will necessitate major improvement in management practices, particularly in the stabilization of tailings piles.

Storage and disposal of spent fuel produced by power reactors is of concern because of the large amount which has already been generated and because of the limited storage capacity available for the spent fuel at reactor sites. Both Parties are currently studying waste management options, but the above factors make it mandatory that a solution to this problem be found rapidly.

Decommissioning of nuclear power plants is of concern since this topic has received relatively little attention to date. Although several alternatives have been suggested, the procedures to be used in an actual decommissioning have not been selected.

Although there are general areas of concern, the impact of specific components of the nuclear fuel cycle on the Great Lakes Basin has, to date, been small. However, some problems, most notably active and abandoned mill tailings piles in northern Ontario and commercial reprocessing waste sites in western New York state, are apparent. While some remedial actions have been taken, as described in Appendix D, future activities in these areas should be closely monitored.

UNPLANNED RELEASES OF RADIONUCLIDES

The International Joint Commission asked the Water Quality Board to establish a procedure to receive and assess information on unplanned releases of radionuclides into the Great Lakes. In response, the United States Nuclear Regulatory Commission (NRC) and the Canada Atomic Energy Control Board (AECB) agreed to provide timely advice to the Water Quality Board, through its Radioactivity Subcommittee, about unplanned releases of radionuclides into the Great Lakes.

Beginning in 1979, the date of implementation of this procedure, the reporting of unplanned releases will be treated as follows: after receipt of information about a given incident from the NRC or the AECB, the Secretary of the Radioactivity Subcommittee will notify the appropriate agency representatives on the Subcommittee who will, in turn, assess the available information. A report will be provided to the Water Quality Board. If the incident is significant, the Board would be informed immediately.

INPUTS FROM MEDICAL AND INDUSTRIAL USES OF RADIONUCLIDES

Medical and industrial discharges of radionuclides through municipal sewage treatment plants have little effect on radioactivity levels in the Great Lakes. Most of the radionuclides reaching the plants are either naturally occurring or due to fallout from weapons testing, although small quantities of short lived radionuclides used in nuclear medicine are present. Most of the radioactivity is removed with the sludge in the treatment of the sewage, and concentrations in the sludge are similar to those found in normal soils. The level of radioactivity remaining in the effluent is less than that found in rainfall.

RADIOACTIVITY OBJECTIVE AND DOSE CALCULATION

In response to a question from the International Joint Commission, the Radioactivity Subcommittee assessed the changes introduced by the ICRP and their significance for Great Lakes water quality. The changes recommended by ICRP, in general, raise the numerical dose limits to specific organs or tissues as compared to those allowed under the older "critical organ" concept. The changes therefore permit a higher concentration of most radionuclides in the Great Lakes. The ICRP changes reflect that organization's re-evaluation of both the risk and the dosimetric methodology associated with exposure to ionizing radiation. The Radioactivity Subcommittee concludes, however, that the objective should remain unchanged for the present since the net effect of these changes cannot be assessed until the new ICRP limits are published.

There are other principles embodied in the 1978 Water Quality Agreement which act to limit ambient radionuclide concentrations. Maintenance or improvement of existing water quality (as set forth in Article IV, Item 1(c)),

while difficult to achieve since a major input is via fallout, is still a fundamental principle. The principle of discharges from nuclear power plants being as low as reasonably achievable (ALARA) will also be utilized. ALARA also applies to other point source inputs, such as from mining and low level waste management sites, but does not apply to such inputs as fallout.

6 WATER QUALITY AND HUMAN HEALTH

As a result of a continuing and growing concern over the potential human health hazards posed by contaminants present in the Great Lakes ecosystem, especially those which bioaccumulate in fish, the Human Health Effects Committee was established early in 1978, reporting both to the Water Quality Board and to the Science Advisory Board. The Committee's terms of reference are to:

- o assess the risk to health posed by contaminants in the Great Lakes ecosystem;
- o review action levels and guidelines for selected substances;
- o provide to the International Joint Commission, through its boards, interpretation and consultation on health matters; and
- o maintain awareness of current advances and knowledge as they relate to human health aspects of the ecosystem.

An early task of the Committee was to review the 1976 Water Quality Board's Appendix E, "Status Report on the Persistent Toxic Substances in the Lake Ontario Basin", and it was decided to initiate studies on lead, and mirex.

In the (1978) final report of PLUARG, concern is expressed over the increasing concentration of lead in sediments, especially those of lakes Erie and Ontario. Nonpoint sources were considered responsible for this phenomenon. The current concern over lead is due to recent evidence that inorganic forms in sediments may be transformed into more toxic organic compounds by biological mechanisms occurring in Great Lakes sediments. The evidence for lead methylation by microorganisms was reviewed by the Committee and it is recommended that additional data be obtained in order to identify and quantify the presence of alkylated lead compounds in Great Lakes sediments and biota.

Mirex has been found in Lake Ontario and at one location in Lake Erie. The compound is biologically stable, scarcely metabolized and lipophilic; hence it is stored in fatty body tissues and organs. Mirex is a teratogen (i.e. causes birth defects, e.g. cataracts) and a suspect carcinogen.

Recently, the Committee reviewed Health and Welfare Canada's toxicity data on mirex and its principal degradation product, 8-monohydromirex (photomirex), both found in wildlife samples from Lake Ontario. Photomirex is 10-100 times more toxic than mirex and, in rat-feeding studies, produced lesions of the testes, thyroid, and liver of males. Herring gull and fish samples from Lake Ontario contain photomirex ranging from 30-50% of the mirex content.

The Committee is reviewing the differences in action levels for mercury in fish between the United States and Canadian regulatory agencies. The Committee

also recognizes that the degree of protection afforded by selenium against methylmercury toxicity is still a controversial issue and suggests that the consumption of fish containing mercury should be regulated in the population groups affected, such as certain native population groups in Ontario, Quebec, and New York.

At its October 1978 meeting, the Committee discussed the problem of establishing criteria for rating the hazards presented by the 400 chemicals recently identified in the Great Lakes by the Water Quality Board's 1977 Appendix E, "Status Report on Organic and Heavy Metal Contaminants in the Lakes Erie, Michigan, Huron, and Superior Basins", in addition to those 50 compounds earlier reported in the 1976 Appendix E. The 1978 Michigan Critical Materials Register formed the basis for review and discussion. Michigan utilizes a hazard assessment methodology which considers categories of health effects. Chemicals are numerically scored as to their hazard and those posing a high environmental concern (i.e. a high score) are included in the Register.

Working with the Michigan document as a prototype, the Committee selected and defined the following health categories for chemical screening and devised an appropriate ranking system for each category:

- acute toxicity
- carcinogenecity
- neurobehavioural toxicity
- reproductive
- heritable mutagenecity
- chronic adverse effects

Using these categories, the Committee members are currently evaluating the 450 compounds noted above and ranking them as to hazard. Possible exposure routes will also be identified.

The method is compatible and consistent with the hazard assessment procedure recommended by the Hazardous and Toxic Substances Workshop Steering Committee (Attachment 1).

The human health hazard evaluation incorporates toxicity information with estimates of exposure or dose in a given period of time, resulting in a ranking as to hazard. The analysis as to hazard to human health could then be combined with assessment of hazard to other elements of the ecosystem in the hazard assessment methodology described in Attachment 1.

7 AIRBORNE POLLUTANTS

In 1977, the Water Quality Board reviewed the information available on the effects of air pollution and atmospheric fallout on Great Lakes water quality (1976 WQB report, p. 61; Appendix C, pp. 17-21). The Board would like to bring the Commission up to date on this subject bearing in mind the broader scope of the revised Agreement and the specific reference to the effects of the long range transport of airborne pollutants on the Great Lakes Basin ecosystem made in Article VI, Section 1 (i).

THE PROBLEM

Previous reports to the Commission from the Water Quality Board, Upper Lake Reference Group, and PLUARG have provided estimates of pollutant loadings to the Great Lakes from atmospheric fallout. Clearly, the atmosphere provides an important source for a variety of pollutants including phosphorus, nitrogen, lead, copper, other heavy metals, sulphates, PCBs, polycyclic aromatic hydrocarbons and other substances. Most recent information is reported in Appendix B.

Concern has arisen not so much from a consideration of air quality and its potential for direct injurious effects, but because the atmosphere is now a proven pathway for the introduction of a broad range of substances into the ecosystem. The ecosystem, then, is subjected to the long term accumulation of airborne substances which can give rise to unexpected environmental degradation. For example, atmospheric levels of PCBs can be well below the level at which direct injurious effects are known to occur, yet fish in areas remote from human activities may contain unacceptable levels.

The Board wishes to emphasize one aspect of this problem, the effects of acidic precipitation on the basin ecosystem. The atmosphere can transport pollutants discharged into it over considerable distances before depositing them in particulate form (dry deposition) or in rain and snow (wet deposition). For this report, acidic precipitation refers to the sum of wet and dry deposition. Furthermore, chemical transformations of air emissions may take place during atmospheric transport. A significant proportion of the materials deposited from the atmosphere in the Great Lakes Basin comes from sources outside the basin.

ACIDIC PRECIPITATION

Virtually all of eastern Canada and portions of the northeastern United States are experiencing annual sulphate loadings 1 to 3 times the level at which acidification begins to take place in susceptible aquatic ecosystems. Southern and central parts of this region appear to be experiencing loadings as high as 10 times their assumed assimilative capacity. As a result, acute acidification of some lakes has already occurred and many more are showing serious signs of stress. The most susceptible lakes may be irreversibly harmed within approximately 10 years and less susceptible lakes within 15

years. The Great Lakes Basin represents only a small fraction of the susceptible land mass. The Great Lakes themselves, because of their large buffering capacity, are not immediately threatened.

The acidity of precipitation in the northeastern United States and eastern Canada is generally 10 to 40 times greater than the normal, although individual storm events can give rise to significantly more acidic precipitation. In general, about two-thirds of this acidity can be attributed to oxides of sulphur and about one-third to oxides of nitrogen. In eastern Canada, wet deposition accounts for about two-thirds of the total sulphur loading and dry deposition for about one-third. In the northeastern United States, dry deposition loading is almost twice as great as wet deposition.

A detailed report on the effects of acidic precipitation is being prepared by the Science Advisory Board.

CONTROL PROGRAMS AND POLICIES

The solution to the problem lies in limiting emissions of oxides of sulphur and nitrogen. The adequacy of these emission control policies of both Canada and the United States with respect to the control of acidic precipitation needs to be assessed by asking to two key questions:

(a) Are the current policies aimed at substantial reductions of emissions of oxides of sulphur and nitrogen?

(b) Do the policies make explicit reference to the control of acidic precipitation?

Although there are substantial differences in the constitutional, jurisdictional, legal and administrative frameworks for air pollution control of existing sources in both countries, there is similarity in the basic approach taken. Air emissions are controlled to meet local environmental requirements based on limiting deleterious or injurious effects. This is achieved by a combination of control at source to limit emissions and tall stacks to dilute and disperse pollutants to meet ambient air quality objectives. In the United States, new sources are subject to technology based standards; whereas in Canada there is no differentiation in the approach taken to new and existing sources.

The nature of the problem of the long range transport of air pollutants is such that the federal governments of both countries must take the lead role both in negotiating a solution and providing the legislative framework within which the state and provincial governments can operate. Based on past performance, a decade may pass before pollution control facilities are brought into operation as a result of international agreement, modification of domestic legislation, and the implementation of new control programs.

UNITED STATES CONTROL PROGRAMS

In implementing the Clean Air Act, United States agencies have mounted an aggressive control program aimed at the reduction of ambient levels of sulphur oxides, nitrogen oxides, and particulates. New Source Performance Standards were promulgated in 1977-1979 for a wide variety of industrial facilities.

These call for a reduction of up to 90 percent for oxides of sulphur and 65 percent or more for oxides of nitrogen for emissions from new coal fired power plants.

EPA's emission offset policy was codified in January 1979. This policy allows the location of new sources in areas not meeting minimum air quality levels only if pollutant levels are reduced from existing sources in amounts greater than will be emitted by the proposed new source. This policy is having a significant impact on the older Great Lakes Basin industrial centers in terms of industrial controls of particulates, sulphur dioxide, hydrocarbons, and carbon monoxide.

In State Implementation Plans currently being revised and submitted to EPA for approval, primary emphasis is being placed in areas where ambient criteria are not attained. Included in such plans are fugitive emission controls which should provide strong regulatory tools for particulates, especially those associated with direct deposition in the Great Lakes.

Prevention of Significant Deterioration regulations were promulgated on June 19, 1978, limiting new sources in clean areas to best available technology and a maximum incremental increase in sulphur and particulate loadings. This provides an additional tool in minimizing increases in downwind rainfall/snowfall acidity.

It is possible, at least theoretically, to incorporate consideration of the impacts of air pollution on water quality in setting emission control regulations. This, however, would be a cumbersome and circuitous process and has not been done to date.

CANADIAN CONTROL PROGRAMS

From a legislative perspective, the control of air pollution in Canada is a shared responsibility. The provinces are responsible for the regulation of common air pollutants, while both the federal and provincial governments are responsible for pollutants which represent a hazard to human health. The federal government is responsible for the international and interprovincial aspects of air pollution.

The federal Clean Air Act provides for prescription of national emission standards for pollutants which constitute a significant danger to public health. National emission standards may also be prescribed for a class or classes of sources where the terms of an international obligation are likely to be violated. The Act also provides for national emission guidelines for other air pollutants. These guidelines are not legally enforceable by the federal government but may be incorporated into provincial law.

In Ontario, air pollution control programs are designed to meet prescribed air quality objectives. Reduction of levels of emissions to meet ambient objectives of oxides of sulphur and nitrogen, and particulates, including heavy metals, is pursued through a program of source control and technology development. A full range of cost effective controls, such as low sulphur coal, improved process applications, e.g. combustion advances or byproduct recovery of sulphuric acid, are some of the technologies employed. The control of fugitive emissions, as well as point or process sources, is an integral parts of the control program.

The Ontario Environmental Protection Act confers a power to pass regulations prohibiting or regulating and controlling the deposit of any contaminant into the natural environment. It is possible to incorporate water quality impacts into the regulations. The Act also sets up an approval function for construction or modification of facilities which discharge contaminants into any part of the natural environment other than water. It is possible to include air pollution impact on water quality in the development of regulations, although this has not been done to date.

THE CURRENT SITUATION

Anthropogenic emissions of sulphur dioxide in eastern North America are estimated to be about 23 million tons per year. Of this, approximately 19 million tons are emitted from United States sources with the majority (60%) coming from the thermal power industry. In eastern Canada, sulphur dioxide is mainly a product of the non-ferrous smelting industry (60%). Anthropogenic emissions of nitrogen oxides in the eastern United States are about 22 million tons per yer and in eastern Canada, approximately 1.4 million tons. In the United States, there is an approximately equal contribution from both fixed and mobile sources. In eastern Canada, approximately 65% of nitrogen oxide emissions come from mobile sources. It should be emphasized that there is no derect correlation between the gross emissions of these pollutants into the atmosphere of both countries and the transboundary flux or transfer of these pollutants. Clearly, emissions in the immediate vicinity of the border have far greater potential for transboundary movement than do emissions from distant sources. There is no clear consensus on net transboundary movement of these pollutants at the present time.

Projections of future increases or decreases in emissions of sulphur dioxide and nitrogen oxides in both Canada and the United States are difficult. A wide range of possible scenarios can be developed based on various environmental, energy, and economic factors. Recent indications are, however, that sulphur dioxide emissions are expected to remain relatively constant in the near term but nitrogen oxide emissions may increase slightly. The most important fact, however, is that current levels of emissions are having a significant deleterious impact on ecosystems in both Canada and the United States.

Several techniques can reduce emissions from the thermal power industry. These include increased energy conservation; increased use of alternative energy sources; and the reduction in emissions from coal burning plants through the use of fluidized bed combustion, flue gas desulphurization, low sulphur coal, and coal cleaning. Some techniques for removal of sulphur from coal fired power plants give rise to a significant solid waste management problem.

Technologies exist to reduce emissions from the non-ferrous smelting industry. These include the production of liquid sulphur dioxide, sulphuric acid, elemental sulphur or metallurgical process change.

In summary, the technology exists to substantially reduce sulphur oxide emissions in both Canada and the United States. To launch a major emission reduction program would be a very costly undertaking. Some early estimates of the annualized costs of a 50% reduction in sulphur dioxide emissions in the

northeastern United States range between $5-$7 billion, while a similar reduction in eastern Canada might cost $350 million a year. Greater levels of reduction may be necessary to alleviate the problem.

In assessing the adequacy of current air pollution control strategies in both countries, it is concluded that:

(1) emissions from existing sources are limited to the extent necessary to meet local ambient air quality requirements and are not a priori designed to reduce total emissions;

(2) the application of such policies has, in part, encouraged the use of tall stacks which tend to increase the long range transport of airborne pollutants;

(3) in the United States, the current emissions level is unlikely to be reduced until new sources, subject to New Source Performance Standards, significantly replace existing sources;

(4) in Canada, under current regulatory programs, no significant reduction in total emissions is foreseen;

(5) the legislation in both countries is limited because it does not explicitly recognize acidic precipitation as a problem to be solved by emission control programs.

(6) the technology is available to substantially reduce emissions from current sources although at considerable financial cost and with the potential for solid waste management problems.

(7) unless emissions are reduced, widespread irreversible harm to ecosystems susceptible to the effects of acidic precipitation will occur within 10 to 15 years.

The Board, therefore, recommends that the Commission ask the Governments, as a matter of urgency, to reduce the total atmospheric emission of oxides of nitrogen and sulphur from both existing and new sources.

Reference: EPA Report 450/2-78-052 - National Air Quality, Monitoring and Emission Trends Report, 1977; and Environment Canada Report EPS 3-AP-78-2 - A Nationwide Inventory of Emissions of Air Contaminants, 1974. (Modifications to 1978 through personal communication with P. J. Choquette.)

8 WATER QUALITY BOARD ACTIVITIES

CHLORINE OBJECTIVE TASK FORCE

The Chlorine Objective Task Force was organized to assess the socio-economic impact of the proposed chlorine objective and the practicality of implementing and monitoring regulatory actions. This is the first time IJC has sponsored an economic and social assessment of an ambient water quality objective. The Task Force is reviewing the probable effects of the objective on the boundary waters and the related social impact. The report is will be completed in the fall of 1979.

The primary intent is to assess the social and economic implications of limiting the residual chlorine discharges from municipal, industrial and power plant facilities to achieve the proposed objective. The Task Force is developing and testing a method for conducting such assessments in the future.

The proposed chlorine objective of 0.002 mg/L is based on the most sensitive use by aquatic life and was determined without explicit consideration of the costs and benefits of its achievement. The task force will identify and measure the magnitude of the costs and benefits of achieving the objective. It will also assess whether the benefits are reasonably commensurate with the costs of alternative ways of achieving the objective. The effort will also aid in identifying the least-cost methods for environmental protection.

In addition to knowing the magnitudes involved, it is important to know which sectors of the economy and society will bear the costs and reap the benefits and to recognize that there are a number of alternatives for realizing intermediate levels of abatement and ambient quality conditions. Some intermediate levels of achievement may, therefore, be more economically feasible. This could mean that the objective would be met only in some locations, or at certain times of the year.

The Task Force reported the following preliminary findings and observations to the Water Quality Board:

1. Economic and social assessments of environmental objectives can be helpful in setting project priorities, identifying least-cost technologies, and in justifying regulatory or enforcement actions.

2. North American chlorine production totals approximately 11 million tonnes per annum. Only 5% of this production is used for purposes of water and wastewater disinfection. Power plant usage is significantly smaller than municipal usage.

3. The contribution of chlorinated organics due to chlorination by sewage treatment and power plants is insignificant when compared to industrial discharges.

4. Industrial contributions of residual chlorine discharges are minimal compared with municipal and power plant sources.

5. Reduction or the elimination of chlorine disinfection at sewage treatment plants would produce the following results: a) progress toward meeting the chlorine objective, b) reduction in operating costs of chlorine disinfection, c) possible increase in public health risks if sewage is not disinfected, and d) uncertain protection of aquatic life because of other contaminants and stressful conditions present in sewage effluents.

6. Although some 150 chlorine-related accidents are reported annually in Canada and the United States, reducing or eliminating effluent chlorination would not likely reduce the frequency of these accidents because of the relatively small usage by this facet of the industry.

7. The major source of chlorinated organics in municipal water supplies is the result of in-plant chlorination combining with naturally occurring humic matter. The chlorination of municipal or industrial wastewater discharges does not contribute significantly to the problem of exotic chemicals in drinking water.

8. Alternative sewage disinfection technologies were evaluated. Ultraviolet light and ozone treatment are the only technologies, new to the Great Lakes Basin, that might be applied to existing treatment plants on a relatively wide basis.

9. Five broad classes of sewage disinfection strategies will be identified and evaluated including:

   a) improving the efficiency of present chlorine disinfection practices;
   b) eliminating disinfection;
   c) chlorinating seasonally on the basis of receiving water needs;
   d) adding dechlorination to present chlorine disinfection processes;
   e) using alternative disinfection techniques.

The Water Quality Board will review the results of the task force analysis of the chlorine objective to determine whether or not this procedure is appropriate for predicting the socio-economic impact for other water quality objectives.

JOINT PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE

The Water Quality Board and the Science Advisory Board organized a task force to review and evaluate the existing phosphorus inputs to the Great Lakes and the target loading in Annex 3 of the 1978 Great Lakes Water Quality Agreement.

The target loads for the 1978 Agreement were prepared by a task force of the Agreement Review Group which was established by the Parties. The members of the task force were assigned to the task by their agencies. Some of these individuals also worked on IJC subgroups, but the IJC or WQB had no direct input into their deliberations. The information they used, was in most cases,

the same basic data used by the WQB and PLUARG but with some additional data and sometimes different methods for estimating total loads.

The sources of information, methods of estimating loadings, and modelling criteria are being reviewed by the task force and recommendations will be made as to the most appropriate methods for estimating loading figures and establishing target loads.

The task force will also evaluate the alternative management strategies to meet the allocated loading limits. The task force is expected to prepare an interim report in the summer of 1979 and a final report by December 1979.

LAND APPLICATION OF MUNICIPAL WASTEWATER

The WQB is conducting analyses for the Commission of information available on land disposal of municipal wastewater. A state-of-the-art review of this treatment method is in the final stages of preparation.

DREDGING SUBCOMMITTEE

A Dredging Subcommittee was formed in February 1979 by the Water Quality Board in compliance with Annex 7 of the 1978 Great Lakes Water Quality Agreement. This Subcommittee will review the report of the International Working Group on the Abatement and Control of Pollution from Dredging Activities which was formed to comply with the 1972 Great Lakes Water Quality Agreement. The Working Group reviewed existing dredging practices, programs, laws and regulations and in its 1975 report, made recommendations on site-specific evaluations of projects and compatible programs to govern the disposal of dredged material in open water.

In the maintenance of navigation channels and harbors in the Great Lakes, substantial quantities of sediment are dredged annually. During the period 1966 to 1972, this amounted to some 60 million cubic metres with the United States dredging activities accounting for 79 per cent of the total.

Since 1975, there has been an increasing commitment to the use of confinement facilities for dredged material (Table 8.1). In 1978, confined disposal was used for approximately 85 per cent and 70 per cent of the dredging quantities from the United States and Canadian activities, respectively.

Construction costs for confinement facilities can substantially increase costs for dredging projects on the Great Lakes. For instance, a facility is being constructed at Pointe Mouillee on Lake Erie by the Corps of Engineers at an estimated cost of $45 million. This site will contain all dredged material obtained during a 10-year period of maintenance and permit dredging in the Detroit River and Rouge River navigation channels, plus all materials which have been accumulating in navigation channels and have not been dredged pending completion of the confined facility. A facility under construction at Thunder Bay, Ontario will cost an estimated $6.4 million and will accommodate the maintenance dredging requirements of Lakehead Harbour for a 20-year period.

TABLE 8.1

GREAT LAKES DREDGING ACTIVITIES 1975-1978

(quantities in thousands of cubic metres)

YEAR	TOTAL VOLUME DREDGED		VOLUME OPEN WATER DISPOSAL	
	U.S.	Canada	U.S.	Canada
1975	6,459	247	1,987	196
1976	5,935	154	1,807	67
1977	5,026	913	1,440	479
1978	5,189	750	768	225

The Dredging Subcommittee is presently reviewing existing practices in both countries relating to dredging activities and plans to develop compatible guidelines and criteria for dredging activities in the boundary waters by December 1, 1979. It is also preparing a register of significant dredging projects with pertinent statistics to allow for assessment of pollution loadings from dredged material to the Great Lakes System.

NONPOINT SOURCE ADVISORY GROUP

The Water Quality Board instructed the Remedial Programs Subcommittee to organize a group to develop a process for reporting on progress made by jurisdictions in complying with the requirements of the 1978 Great Lakes Water Quality Agreement to control pollution from nonpoint sources.

POLLUTION FROM LAND USE ACTIVITIES REFERENCE GROUP

The Water Quality Board reviewed the report of the Pollution from Land Use Activities Reference Group (PLUARG) and sent its comments to the Commission as required in its role as principal advisor to the Commission (Attachment 3). The comments highlighted a number of concerns, particularly those associated with the control of phosphorus, which the Board feels should be clarified before consideration of further phosphorus reduction measures. The Joint Phosphorus Management Strategies Task Force will address the phosphorus questions posed by the WQB.

APPENDICES

The subcommittees of the Water Quality Board and its Implementation Committee have prepared annual reports some of which are published as separate Appendices to this Seventh Annual Report.

These appendices contain information and data that form the basis for the Board's report, but also contain independent viewpoints of the subcommittees which may not necessarily be reflected in the Water Quality Board report.

A series of reports addressing specific subject matter have been published over the years as appendices to the Water Quality Board Annual Reports.

SERIES DESIGNATION	APPENDICES TO THE SEVENTH ANNUAL REPORT
A - Water Quality Objectives	
B - Surveillance of Water Quality	X
C - Remedial Programs	
D - Radioactivity	X
E - Contaminants in the Great Lakes	
F - Hazardous Waste Disposal	
G - Health Effects	X

The Remedial Programs Subcommittee did not publish an Appendix C this year. An inventory of compliance information in the form of a computer printout is available from the IJC Regional Office and offices of the federal, state, and provincial pollution control agencies in the Great Lakes Basin.

Copies of these appendices may be obtained from:

International Joint Commission
Great Lakes Regional Office
100 Ouellette Avenue
8th Floor
Windsor, Ontario N9A 6T3
Canada

or by telephoning:

(313) 963-9041 in the United States
(519) 256-7821 in Canada.

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Secretary:

L. B. O'Leary
Great Lakes Regional Office
International Joint Commission
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GLOSSARY

With the intent of giving the general public a better understanding of its report, the Water Quality Board prepared this glossary of terms and abbreviations commonly used in the field of water quality control.

Adequate treatment - (For municipalities) United States: minimum of secondary treatment with maximum effluent concentrations of 30 mg/L each for BOD and for suspended solids and 1.0 mg/L for total phosphorus; Canada: minimum of secondary treatment or equivalent with maximum concentrations of 20 mg/L each for BOD and suspended solids.

Bioaccumulate - concentrate in fatty tissues of organisms.

Bioassay - use of living organism to determine the biological effect(s) of a substance, condition or factor.

Biomagnify - increase in concentration in the food chain.

Biomass - the amount of living matter present in a habitat in a specific amount of water.

BOD - Biochemical Oxygen Demand; amount of oxygen used by micro-organism present in a water or sewage sample in 5 days. It is a measure of the effect of decomposition of organic matter on the oxygen content of the water.

Chlorophyll a - a specific type of chlorophyll used as an indicator of excessive nutrients.

Cladophora - a nuisance algal species which is found in nutrient-rich areas of the Great Lakes.

Consent Decree - a judgement by a court which puts into effect a legally enforceable remedy.

Control order/requirement and direction order - enforceable orders in Ontario.

Criteria - numerical limits of pollutants established to protect specific water uses.

/d - per day

DDE - decomposition product of DDT; highly persistent.

DDT - dichloro-diphenyl-trichloroethane; a polychlorinated hydrocarbon; highly persistent insecticide.

Deleterious substance - substance which can be harmful.

D.O. - dissolved oxygen. Oxygen dissolved in water, necessary to support aquatic life.

Ecosystem - interactive system of a biological community and the total environment in which it exists.

Effluent - water discharged from a pipe or treatment plant.

Entrainment of fish - when fish are pulled into and through pumps and pipes such as are used in processes requiring cooling waters.

EPA - United States Environmental Protection Agency

Eutrophic - abundant in nutrients; waters highly productive in plants and organisms frequently resulting in oxygen depletion.

Grey water - waste from kitchen, bath, shower, and cleaning water on ships.

Guidelines - suggested criteria for programs or effluent limitations.

^{3}H - tritium; radioactive isotope of hydrogen with atomic weight of 3.

Hypolimnion - part of lake below the thermocline.

ICRP - International Commission on Radiological Protection

IJC - International Joint Commission. Established by the Boundary Waters Treaty of 1909 with 3 United States and 3 Canadian members.

Impingement of fish - when fish are forced against a structure.

Irradiate - to treat by exposure to radiation.

L - liter

Loadings - total weight of pollutant to a water body over a specified time, e.g. tonnes per year of phosphorus.

m^3/d - cubic meters per day

Manifest system - in this instance, written record of materials containing information about their origin and all steps in handling up to disposal or destruction.

MGD - millions of gallons per day

mg/L - milligrams per liter

Mirex - dodecachloropentacyclodecane; an insecticide and fire retardant for plastics, rubber, paint, paper, and electrical goods.

Mixing zones - a designated area in which Agreement water quality objectives need not be met; area where discharges mix with receiving waters.

MOE - Ontario Ministry of the Environment

Nitrification - conversion of nitrogen from one form to another through oxidation.

NPDES - National Pollutant Discharge Elimination System; a permit system limiting municipal and industrial discharges, administered by EPA and the states.

Nutrient - materials that are necessary for growth, principally phosphorus and nitrogen.

Organochlorine - carbon-based compound which contains chlorine.

Oxygen depletion rate - speed at which the oxygen is removed from the water.

PCBs - polychlorinated biphenyls; group of more than 200 persistent and bio-accumulating compounds now restricted to closed system (no discharge) uses; formerly used in lubricants, duplicating paper, die casting, paints, coatings, adhesives, fireproof sealants, and plastics.

pCi - picocurie; one trillionth of a curie, the unit for measuring radio-activity relating to disintegration of radionuclides.

Persistent compound - substance which remains in the environment.

pH - an indicator of the acidity or alkalinity of water on a scale from 0 to 14; 7 is neutral; low numbers indicate acidic conditions, high numbers alkaline.

Phosphate - salt of one of several phosphoric acids used as building block for detergents, a constituent of fertilizer.

Primary treatment - mechanical removal of floating or settleable solids from wastewater.

Problem area - location of degraded water quality where measurements show that Great Lakes Agreement water quality objectives or domestic criteria are exceeded.

^{226}Ra - radium-226; a radioactive isotope of the element radium with an atomic weight of 226.

Radionuclide - an element with an unstable nucleus which will eventually dis-integrate releasing energy.

rem - roentgen equivalent man; standard radiation dose unit.

SAB - Great Lakes Science Advisory Board

Secondary treatment - primary treatment plus bacterial action to remove organic parts of the waste.

Sludge - solids removed from sewage.

^{90}Sr - a radioactive isotope of the element strontium with atomic weight of 90.

STP - Sewage Treatment Plant

t - tonne (metric ton) = 1,000 kilograms = 2,205 pounds

TDS - total dissolved solids; dissolved materials.

Thermocline - the boundary between the water in the top part and the bottom part of a lake. The top (epilimnion) and bottom (hypolimnion) water do not mix because their temperatures are different; in the summer, the surface water is warmer. After a thermocline forms in the spring, it blocks the transfer of oxygen to the bottom water, so there may not be enough oxygen for living organisms.

Toxic pollutants - those compounds which, in sufficient amount on or in an organism can cause death, disease, mutation, deformity or malfunction in that organism or its offspring.

TSS - total suspended solids; small particles of solid materials.

µg/g - micrograms per gram

Water quality objectives - under the Great Lakes Water Quality Agreement, goals set by the Governments of United States and Canada for protection of the uses of the Great Lakes.

Water quality standard - a criterion or objective for a specific water use that is incorporated into enforceable regulations.

WQB - Great Lakes Water Quality Board

WWTP - Wastewater Treatment Plant

ATTACHMENT I

REPORT OF THE STEERING COMMITTEE FOR TOXIC AND HAZARDOUS SUBSTANCES WORKSHOPS JUNE 1979

CONCLUSIONS

1. The state of the art of hazard assessment is in an early stage of development, and is not as advanced as first assumed.

2. Virtually all the resources available for toxic substances control programs have been devoted to the early states of hazard assessment (specifically, list development) and to regulation.

3. There is a lack of coordination between the hazard assessment and control phases of toxic substances programs.

4. There are fundamental differences between the program orientations at the national level and at the local level (state, provincial, and national). The time frame for action at the local level is much shorter than that at the national level. Thus, hazard assessment needs of the two levels are different.

5. Hazard assessment signifies different things to different people (agencies), is implemented in different ways, and is frequently confused with risk assessment.

6. There is a lack of communication - both within and between hazard assessment programs - which has resulted in fragmentation and duplication of efforts.

7. There is a lack of understanding of Annex 12 of the Agreement and, consequently, of a commitment to implement it.

8. There is a serious lack of toxicological information and of information on the physical and chemical properties of chemical substances; information now available is not currently available in a central storage location.

9. Priority setting by hazard assessment is an essential part of toxics programs but should consume only a small part of the resources committed to the program.

10. Some viable (operable) hazard assessment procedures are underway and there is a definite need to build on these.

BACKGROUND

Based on the above conclusions and on the discussion at the workshop, the Committee has arrived at the following statement of the general hazard assessment problem in the Great Lakes Basin.

THE BASIC PROBLEM

There is a very large number of chemicals which are potentially toxic, either singly or in combination, present in the Great Lakes Basin. We need to (1) continually identify chemicals of concern, (2) focus scarce resources on a small number of chemicals of higher concern in order to control these at the source, (3) develop systems to provide early warnings and assessment, and (4) conduct research on these substances to provide necessary decision information.

As a first step in improving hazard assessment in the Great Lakes Basin, the Committee suggests the following as a general operational definition:

> Hazard Assessment is an orderly process using available data and information in a concerted, logical manner to screen chemical substances and to identify those substances on which scarce resources should be focussed.

Hazard Assessment consists of a series of progressively more detailed screens that are used for different purposes. It is a dynamic, evolutionary process that involves transfer of information between levels in the program, and improvement in methods as more information becomes available, as well as a reassessment of chemical substances on a regular basis.

A general scheme of the role of hazard assessment in overall toxic substances control programs is suggested in Table A-1. The starting point for the scheme is the chemicals in use (63,000 substances estimated).

RECOMMENDATIONS

1. The Steering Committee recognizes an immediate need for a hazard assessment scheme to screen the candidate substances found in the Great Lakes Basin so that a needed toxic substances program can be planned and carried out in a critical manner. The following measures should be carried out:

   (a) the existing Michigan hazard assessment process should be used as the process for initially screening the candidate chemical substances,

   (b) a list of candidate chemicals should be submitted from various Great Lakes Basin sources for the initial screen,

   (c) the data base derived from this process should be made available for the Great Lakes Basin agencies. The whole screening process should be as open as possible to enable information to be made available at every step. The data base should be made compatible with the United States federal chemical information base and ISHOW, the data base developed under the Science Advisory Board's sponsorship.

   (d) a clearing house pertaining to activities on hazard assessment of toxic substances should be established. The information inventory should be updated on a regular and frequent basis,

   (e) similar, well-planned and coordinated efforts should be instituted for the other parts of the toxic substances program to establish:

i) an additional screening process using inventory data, use patterns surveys, and early warning monitoring systems to further refine the candidate list.

ii) a risk assessment process.

2. A new working group chosen from regulatory agency staff actively engaged in hazard assessment should be established to develop and implement the hazard assessment process. Full time staff should be dedicated solely to this activity to assist the work group. Contract resources should be made available to the work group.

3. Other workshops planned (Early Warning Systems and Data Management and Acquisition) should be deferred until the activities of the hazard assessment working group are defined.

TABLE A-1

OVERALL TOXIC SUBSTANCES CONTROL SCHEME

SCREEN	FOCUS OF EFFORT	DEGREE OF DETAIL	NUMBER OF SUBSTANCES
First Level	Priority lists, chemicals found through monitoring, preliminary inventories, use-pattern surveys	General	Large
Second Level	Hazard assessment of the chemicals through examination of physical, chemical and toxicological properties. No effort is made to rank the chemicals passing through the screen. An example of this screening process is the Michigan Critical Materials Hazard Assessment.		
Third Level	Production, use, location, special studies, exposure levels, human + ecological effects monitoring - equal effort given to all substances.		
	Hazard Assessment Stops Here		
Fourth Level	Risk assessment, social, economic, political factors		
Fifth Level	Decision on control		
Sixth Level	Regulation, enforcement, and surveillance	Specific	Small

ATTACHMENT II

HAZARDOUS WASTE CONTROL PROGRAMS

CONCLUSIONS BY THE WATER QUALITY BOARD REPORTED IN JULY 1978

The national governments in both countries have stated that the responsibilities for control of hazardous wastes rests primarily with the state or provincial level of government. The federal governments are involved with certain aspects of siting and interstate, interprovincial, and international transportation of waste materials.

The most difficult problem at the present time is the location of landfill sites and liquid industrial waste facilities. It appears that more and more government intervention may be required in the siting and operation of both types of facilities.

The technology for waste processing is generally available, but the development and application of technology at the waste source or within manufacturing processes would be useful in reducing the problem.

There is an obvious need for a concerted program involving, primarily, federal and provincial or state levels of government to advise people in objective and analytical terms as to the character of the problem and the solutions available. They should be advised as to the necessity of developing solutions and the consequences of not developing solutions to hazardous waste disposal problems in their communities.

The Board's interest is within the geographical limits of the Great Lakes Basin which contains a significant portion of the industrial waste generated in both countries. It is evident that the scale of solutions that must be developed to solve this problem is not restricted to the Great Lakes Basin. Therefore, recommendations will have to be made to countries and different levels of government within those countries to adequately address the problem.

The following concepts should be addressed in developing programs in the United States and Canada:

1. The Great Lakes jurisdictions should adopt compatible regulations for the classification, identification, transportation, and disposal of hazardous wastes. These regulations should:

   (a) Establish a system of manifests to ensure governmental control of waste management and the protection of public health and the environment. Manifests should originate with the waste generator and accompany each shipment from its original production through its ultimate disposal or destruction.

   (b) Require waste generators to identify their wastes, inform agencies of their plans for disposal, and obtain approval of disposal plans.

(c) Require that all those engaged in generation, transportation, storage, and disposal of hazardous waste provide bonds to ensure safe disposal of the waste.

2. All jurisdictions should develop procedures for the approval of processes for safe disposal of specific categories of waste and the location of low-risk sites for waste handling facilities.

3. Jurisdictions should identify manufacturing methods that result in waste products that are difficult or impossible to dispose of and, following that, require modification of such methods to eliminate or reduce the quantities of such wastes over specified time limits.

4. Each jurisdiction should specify a state or provincial agency to approve of sites for specific waste disposal processes and to publicly identify and explain the location of approved sites for safe disposal of each category of hazardous waste.

5. Feasibility studies to investigate acquisition and/or operation of government-owned disposal sites should be initiated.

6. All Great Lakes jurisdictions should cooperate on establishing international, strategically located, properly operated disposal sites.

7. Governments should discourage the imposition of bans on the transportation of hazardous wastes across jurisdictional or international boundaries by allowing unrestricted movements when carriers meet requirements of a proper waste manifest and have proof of advance approval by the receiving jurisdiction.

8. Great Lakes jurisdictions, in addition to receiving public comment, should engage in public education programs to stress that the use of approved methods and sites ensures safe, adequate hazardous waste disposal.

ATTACHMENT III

REVIEW OF THE PLUARG FINAL REPORT TO THE INTERNATIONAL JOINT COMMISSION

by the
GREAT LAKES WATER QUALITY BOARD
OCTOBER 1978

The Water Quality Board commends the members of PLUARG and those associated with the Reference Group for their successful efforts in dealing with an exceedingly difficult and complex aspect of Great Lakes pollution. In completing its task, PLUARG has increased understanding of nonpoint pollution and mass loadings to the lakes. In one sense then, PLUARG constitutes the final part of a trilogy of baseline line studies of Great Lakes pollution along with its companion groups, the Upper and Lower Lakes References. At the same time, the Board appreciates that the subject matter of PLUARG, that of nonpoint source pollution, differed wholly in kind and quality from that of the two previous reference studies. PLUARG's unique contribution was to place land-based pollution sources to the Great Lakes in the context of an ecosystem perspective.

It is clear in reviewing the final summary volume and in examining the numerous technical reports of PLUARG, that much innovative and arduous scientific work was undertaken in fulfilling the terms of the reference. It is recognized that PLUARG often worked at the outer limits of existing knowledge, not only in undertaking new research, but also in organizing existing knowledge. The Board also wishes to acknowledge the scientific excellence that was achieved.

The Board is pleased to report to the Commission that overall, it supports the findings of PLUARG. In particular, it finds that the Reference Group has satisfactorily answered its first two reference questions: "Are the Boundary Waters of the Great Lakes System being polluted by land drainage?" and "If the answer to the foregoing question is in the affirmative, to what extent, by what causes, and in what localities is the pollution taking place?". In addition the Board supports the recommendations for further work contained in Section IV of the report.

The Board does, however, have some questions and suggestions regarding a number of the conclusions and recommendations made by PLUARG contained in Section III, which is largely in response to the third question contained in the reference: "If the Group should find that pollution of the character just referred to is taking place, what remedial measures would, in its judgment, be most practicable and what would be the probable cost thereof?".

The Board does not dispute any of the factual findings of the PLUARG as reported in Sections 1 & 2 of its report, nor does the Board disagree with principles underlying the PLUARG's recommendations. The Board, however, does weigh some of these findings differently from PLUARG and, therefore, has some reservations regarding some of the recommendations of the group. These

reservations primarily center around the control of phosphorus as a whole lake problem.

Although a significant portion of the PLUARG report is devoted to a discussion of phosphorus, attention is also directed to other problems which relate to "other nutrients, pest control products, sediments, and other pollutants". Indeed, in the ordering of remedial priorities, recommendations concerning toxic substances and radioactivity should be borne in mind.

CONTROL OF PHOSPHORUS

1. LOCAL AREA PROBLEMS

The Board concurs with PLUARG that remedial actions are required in areas which are contributing directly to a localized nearshore phosphorus problem (i.e. culturally accelerated eutrophication). PLUARG pointed out a number of areas where the general water quality objectives of the Agreement and/or local requirements as set by the jurisdictions are violated. In such instances, the Board concurs that remedial measures be immediately implemented and would suggest that it be left to the local jurisdiction to decide upon the most effective measures - point source controls, nonpoint source controls, or a combination thereof - by utilizing the management framework put forward by PLUARG.

2. WHOLE-LAKE PROBLEMS

Recommendation 3.2.2 in the PLUARG report raises three fundamental issues which the Board feels must be addressed before this recommendation is acted upon. These concerns include the calculation of current loadings, the designation of target loads and the programs necessary to reduce present loads to the target loads.

a) Current Loads

The calculation of current loadings by the Reference Group is somewhat larger than those reported by the Surveillance Subcommittee in its annual report to the Board. The Board is confident that the two estimates are inherently compatible; however, that has yet to be demonstrated although attempts are underway. The differences, although small, are significant when compared to the relative magnitude of nonpoint P loading reductions recommended by PLUARG. Thus, these variations must be adequately explained before commitments are made to implement nonpoint control programs which promise comparable loading reductions.

b) Target Loadings

The target loads for the Lower Lakes contained in the 1972 Agreement are based upon what could be accomplished by controlling sewage treatment plant effluents to the level of 1 mg/L phosphorus at plants larger than 1 million gallons per day. As such, the achievement of these loads was not associated with meeting a specific, predicted water quality in the lakes. Over the past few years, significant advances have been made in our knowledge of the process of eutrophication and consequently it is possible to predict, with greater precision than hitherto possible, the relationship

between phosphorus loads and resulting water quality. This was the route followed by the Parties in their review of the 1972 Agreement and is a significant departure from the approach formerly employed.

Two sets of proposed target loadings exist which are a cause of additional confusion. One set was developed by a bilateral Canada-United States group during the course of the Fifth Year Review. These proposed target loads have been incorporated in the 1978 Agreement as "tentative target loads" and are subject to confirmation by the Parties through an eighteen-month review process. These proposed targets were further refined by PLUARG, primarily for the Upper Lakes on the basis of more recent information. It is important to note that the loadings in the 1972 Agreement still prevail and that the Parties have yet to conduct a formal examination of the tentative target loads.

In the Lower Lakes, the "tentative target loads" were developed using computer models. These targets are directed towards the maintenance of aerobic conditions in hypolimnetic waters of Lake Erie and the restriction of nuisance growths of algae in both lakes Erie and Ontario. For the Upper Lakes, the loads were calculated on the basis of all municipal STPs (with capacities greater than 1 million gallons per day) achieving 1 mg/L in their effluent. (There does not appear to have been rigorous peer group evaluation of either the water quality objectives or the models. As a consequence, there is a degree of uncertainty with respect to the derived target loads.)

Therefore, until these tentative targets are confirmed or changed by the Parties under the 1978 Agreement, the Board would be acting prematurely if it supported the call for immediate reductions in phosphorus loadings from nonpoint sources as well as existing point sources to improve an as yet undefined whole lake problem.

c) Remedial Programs

It is self-evident that remedial measures must be designed to meet environmental objectives in a cost-effective and practical manner. A basic factor in designing remedial programs for phosphorus loading is the form in which the phosphorus is present. PLUARG made significant progress in establishing the biological availability of phosphorus containing compounds and substances and used this, in part, to establish priorities for remedial programs. An agreed upon definition of "available phosphorus" is still to be determined. Thus, a great deal is still unknown and more information is required before the cost effectiveness of various remedial programs can be estimated with a sufficient level of confidence.

PLUARG presented a comprehensive package of remedial measure options for reducing phosphorus inputs to the lakes based on the assumed disparity between target phosphorus loads and projected total lake loads.

These fall into the categories of additional controls at sewage treatment plants and reductions in nonpoint sources from agricultural and developing urban areas. As indicated above, the Board has general reservations on the appropriateness of these programs because of the unresolved aspects of phosphorus availability and the problem with variability of hydrologic and

loading data for tributaries as it affects target loads. These factors require further consideration before recommendations on implementing cost-effective remedial measures can be made with confidence.

i) POINT SOURCE CONTROLS

The Board has some specific reservations about the proposal to achieve 0.5 mg/L P in the effluent from sewage treatment plants larger than 1 MGD. The basis of the PLUARG recommendation is acknowledged as being the best information available at this time. However, the Board has reservations concerning the practicality of consistently obtaining the 0.5 mg/L P level, especially at the larger plants, and in the absence of additional stages of treatment. This reservation is made in full recognition that some plants are already meeting this effluent level and that some jurisdictions are in the process of instituting this requirement in certain localities to meet local problems.

The following summary of phosphorus load reductions due primarily to the phosphorus limitations in detergents and removal of phosphorus at municipal sewage treatment plants indicates the need for serious consideration before recommending further remedial measures based on whole lake phosphorus considerations.

Lake Erie

The direct point source phosphorus load to Lake Erie has been reduced from approximately 10,000 tonnes per annum (t/a) in 1972-73 to 5,700 t/a in 1977 and is expected to be 2,100 t/a when all controls are in place for the 1.0 mg/L phosphorus effluent limit. These loading data are taken from those generated by the Surveillance Subcommittee.

Loads for tributaries have varied in the range of 6,500 t/a to 11,300 t/a from 1972 to 1977, the variation being largely attributable to a combination of improvements in measuring methods and climatological conditions.

The total load to Lake Erie including atmospheric, tributary, connecting channel and direct loads in 1977 was 14,576 tonnes. When all point sources reach 1.0 mg/L, the total load would range from 10,200 t/a to 16,200 t/a depending on tributary runoff, and compares favourably with the 1976 target load of 14,600 tonnes. Total phosphorus loads (excluding atmospheric loads) to Lake Erie were reduced from 17,450 tonnes in 1972 to 13,457 tonnes in 1977 resulting in a reduction of 3,993 tonnes.

Lake Ontario

The direct point source phosphorus load to Lake Ontario has been reduced from approximately 6,300 t/a in 1972-73 to 2,600 t/a in 1977, and is expected to be 1,300 t/a when all controls are in place for the 1.0 mg/L phosphorus effluent limit.

Loads from tributaries have varied in the range of 2,800 t/a to 5,000 t/a from 1972 to 1977.

The total load to Lake Ontario including atmospheric, tributary, connecting channel, and direct loads in 1977 was 8,935 tonnes. When all point sources reach 1.0 mg/L phosphorus in the effluent, the total load would range from 7,600 t/a to 9,600 t/a depending on tributary runoff, and compares favourably with the 1976 target load of 9,072 tonnes.

While the Board would point out that these reductions have nearly brought down current loads to below 1972 Agreement target loads, it recognizes that new knowledge and information gained since 1972 must now be considered.

ii) NONPOINT SOURCE

PLUARG has made substantial progress in developing a nonpoint source strategy for the basin as a whole. Its approach results in the identification of areas and land uses for which nonpoint source controls would be particularly cost-effective, at different levels of control. This represents a significant advance in information and in planning for the Basin as a whole, and is beginning to be taken into account by some planning agencies in the jurisdictions. PLUARG is to be commended for this pioneering effort.

However, the new approaches and strategies employed merit close study. In particular, only a few types of controls, requiring little expenditure, have been found cost-effective. For other levels of management, when the costs of controls are allocated solely to phosphorus, other benefits which result, such as erosion control, must be fully recognized.

d) Conclusions

In order to speed the resolution of these issues, it is proposed that the WQB and RAB (now Science Advisory Board) jointly undertake an investigation of these unresolved matters and advise the Commission of their findings. The Co-Chairmen of the boards have agreed to this proposal in principle, subject to a more detailed discussion with the Commission on scope and timing. The WQB feels that although such an effort is warranted on the grounds listed above, it would also be of substantial benefit to the Parties in their forthcoming negotiations. The Commission would, in essence, be in a position to provide to the Parties an objective data base which could provide a mutually acceptable starting point for negotiations on the apportionment of phosphorus loadings between the Parties. The Commission may thus conclude that the Parties should be advised of its proposed additional study and seek their concurrence.

SEDIMENT CONTROL

The Board recognizes that sediments constitute a pollution problem in two major ways. As pollutants in themselves, sediments cause turbidity and siltation problems in harbours and other waters. As carriers sediments

contribute pollutants, including phosphorus, to the lakes. Where sediments are associated with localized problems, the Board would recommend the development and implementation of remedial measures by the local jurisdictions. In the absence of a defined local problem, measures for controlling sediment from agricultural and developing urban lands constitute a preventative approach which PLUARG has recommended. This is described below.

PLUARG recommends sediment control for some agricultural areas and developing urban areas. In agricultural areas, it is noted that level 1 reduction can be achieved with little or no cost to the agricultural industry and that elements of levels 2 and 3 can, in certain instances, be instituted on the basis of improved agricultural productivity. In these areas, the Board recommends that a sediment control program be instituted by way of guidelines and codes of practices and, as a priority, be applied to hydrologically active areas through the utilization of PLUARG methodology. Recognizing that phosphorus is transported by such sediments, it is further recommended that this approach be applied to guide the application of synthetic and natural fertilizers.

With respect to developing urban areas, the Board concludes that control programs associated with best management practices for erosion control be instituted wherever possible.

ORGANIC COMPOUNDS, PESTICIDES, LEAD, AND MICROORGANISMS

The Board recognizes that PLUARG's comprehensive approach to the reference facilitated the identification of pollutants which were manifest in land drainage and other nonpoint sources. For organic compounds, pesticides, lead, and microorganisms, the Board would point out that controls are for the most part best directed at their specific source, and in fact many controls are in place or in the process of implementation. The Board is in the process of reviewing the microbiological objective. This review is examining the adequacy of existing criteria in regard to microorganisms in body contact recreational waters receiving runoff from urban and agricultural sources.

DEVELOPMENT OF MANAGEMENT PLANS

The Board supports the principles underlying the concept of a management plan as a comprehensive approach to control pollution from nonpoint sources. Further, the Board would point out that such management plans are not only consistent with the ecosystem concept but serve to facilitate a direct application of the concept of actual pollution problems.